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VOL. CXXXV.—No. 3521] LONDON: FRIDAY EVENING, JUNE 22, 1923 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Wanted at Once, Temporary ENGINEERING ASSISTANTS with good experience in design of Docks and Heavy Masonry; also ASSISTANT experienced in design of Reinforced Concrete Wharves. Preference given to ex-Service men.

Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copy of recent testimonials, to CIVIL ENGINEER-IN-CHIEF, Admiralty, S.W. 1. 2772

Assistant Engineers Required by the GOVERNMENT of HONG KONG for the HARBOUR WORKS DEPARTMENT, for three years' service, with possible extension. Salary £460, rising to £500 by annual increments of £20. Salary is paid in dollars at Government rate of exchange, at present fixed at 2s. to the dollar. Free passages. Candidates, age 24 to 30, must be unmarried and excellent draughtsmen, well qualified in levelling, land and marine surveying and sounding. Must have been regularly educated and trained as civil engineers in the special branch of dock and harbour engineering, and have had subsequent experience in the design and construction of general dock and harbour works. Should be connected with the Institution of Civil Engineers and have passed the examination qualifying for election as associate members or possess an University Degree or Engineering College Diploma exempting therefrom.

Apply at once by letter, stating age and giving particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Hong Kong 11,074. 2771

Assistant Engineer Required by the GOVERNMENT of the GOLD COAST (Takoradi Harbour Works), for one tour of twelve to eighteen months' service, with possible extension. Salary £720 a year. Free quarters and passages. Liberal leave in England on full salary. Candidates, age 30 to 40, should be capable Civil Engineers, with Mechanical and Electrical Knowledge, and should have had experience in Railway and Harbour Works Construction, together with thorough Technical and Drawing-office Training and good experience in the Design, Construction, Maintenance and Lay-out of Heavy Engineering Works, together with plant for same. Graduate preferred.

Apply by letter, stating age, whether married or single, qualifications and experience, to Messrs. STEWART and McDONNELL, 6-7, Cowley-street, London, S.W. 1. 2819

"THE COMPANIES (CONSOLIDATION) ACT, 1908."
H. J. OAKLEY and JONES and COMPANY, Limited.

Notice is Hereby Given, PURSUANT to Section 188 of the Companies (Consolidation) Act, 1908, that a MEETING of the CREDITORS of the above-named COMPANY will be held at the HOLBORN RESTAURANT, LONDON, W.C. 1, on TUESDAY, the 26th day of JUNE, 1923, at 2.30 o'clock in the afternoon.

Dated this 13th day of June, 1923.

LESLIE C. STEWART, Liquidator.
2776

ADJUDICATION OF MATERIAL FOR BORING FOR PETROLEUM.

The "Compañia Franco-Española DE PETROLEOS, S.A.," at San Sebastian (Spain), 39, Rue Prim (telegraphic address, Petroleum), asks TENDERS for the SUPPLY of—

1. FIVE COMPLETE BORING APPARATUS, for a maximum depth of 1,500 metres.
2. FIVE COMPLETE TRANSPORTABLE APPARATUS for Exploration Boring to a depth of about 300 metres.

Establishment specialising, which could be interested, should apply to the said company, "COMPANIA FRANCO ESPANOLA DE PETROLEOS, S.A.," which will give the specifications for this adjudication of material destined to make ten borings in its petroleum concessions in various regions of Spain. 2818

UNIVERSITY OF DURHAM.

Armstrong College,
NEWCASTLE-UPON-TYNE.

LECTURER IN CIVIL ENGINEERING.

The Council of Armstrong College invite APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING. Candidates must be qualified to teach Surveying and have practical experience and a University Degree. Salary £350 to £400 per annum, according to qualifications. Duties to commence 1st October, 1923. Ten copies of applications and of not more than three testimonials should reach the undersigned not later than 7th July, 1923.

J. Y. T. GREIG, Registrar.
2725 Armstrong College.

West Ham Municipal College,
ROMFORD-ROAD, STRATFORD, E. 15.

APPLICATIONS are INVITED for the POST of full-time ASSISTANT TEACHER in the Department of Engineering from candidates with University Degree and works experience. Salary in accordance with the Technical Burnham Scale for the London area, less 5 per cent., and subject to deduction for superannuation.

Forms of application may be obtained from the Principal, and should be returned not later than the 4th July, 1923.

GEO. E. HILLEARY, Town Clerk.
2751

County Borough of Southend-ON-SEA.
"SANDBERG" STEEL RAILS.
BRITISH MANUFACTURE.

The Corporation of Southend-on-Sea invite TENDERS for the SUPPLY and DELIVERY of 160 TONS of "SANDBERG" STEEL TRAMWAY RAILS, B.S. Section No. 4, of British manufacture. Specification, form of Tender, and particulars can be obtained upon application to Mr. Robert H. Dyer, Borough Engineer, Municipal Buildings, Southend-on-Sea, upon deposit of a cheque for One Guinea, which will be returned upon receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Steel Rails," addressed to the undersigned, must be delivered not later than 9 a.m. on Thursday, July 5th, 1923.

The Corporation will not be bound to accept the lowest or any Tender.

By Order
H. J. WORWOOD, Town Clerk.

Municipal Buildings,
Clarence-road, Southend-on-Sea,
June, 1923. 2774

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

New Engineering Works at Derby (With a Two-Page Supplement).

Institute of Transport Congress at Sheffield.

Spiral Bevel Gears—No. I.

The Ideal for Efficient Steam Generation.

A Large Winding Drum.

Some New Forms of Switchgear.

State Coal Mines.

A Cold-Starting Oil Engine.

PUBLIC NOTICES

Borough of Portsmouth.
FLATHOUSE QUAY.—REPAIRS AND REINFORCED CONCRETE STEPS.

The Portsmouth Town Council invite TENDERS for the CONSTRUCTION of and MAINTENANCE in thorough repair for 12 calendar months from the completion thereof of the following WORKS, that is to say :—

The ERECTION of a COFFERDAM.
The RECONSTRUCTION of about 60 FEET of QUAY WALL and the CONSTRUCTION of a FLIGHT of REINFORCED CONCRETE STEPS.

Copies of the drawings of the scheme, conditions of tendering, general conditions and specification can be obtained on application (accompanied by the sum of £2, which will be refunded on the return of the documents within one week or on the receipt of a bona fide Tender) to Mr. Arthur W. Ward, Borough Engineer, Town Hall, Portsmouth.

The work will have to be carried out under the conditions of the Government Unemployed Grants Committee and the trade union rules in force in the borough.

Tenders, marked "Tender for Repairs, Flathouse Quay," are to be sent in on the forms supplied and must reach the undersigned not later than 10 a.m. on Thursday, 28th June, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

F. J. SPARKS, Town Clerk.

The Town Hall, Portsmouth,
16th June, 1923. 2782

City of Hull.
ELECTRICITY WORKS EXTENSIONS.
CONTRACT NO. 6.

The Corporation are prepared to receive TENDERS for the BUILDERS' and FERRO-CONCRETE WORK required in the CONSTRUCTION of PONDS, FOUNDATIONS, &c., for WATER COOLING TOWERS, PUMPING STATION, INLET and OUTLET to DRAIN, and other Works.

Forms of Tender, specification, and quantities may be obtained at the City Engineer's Office on payment of £1 deposit, which sum is returnable upon receipt of a bona fide Tender.

Remittances should be made payable to Mr. T. G. Milner, City Treasurer and Accountant.

Tenders, endorsed "Tender for Electricity Works Extensions—Builders' and Ferro-concrete Work," are to be addressed to the Chairman of the Electricity Committee and delivered at the Town Clerk's Office before Noon on Friday, 6th July.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
F. W. BRICKNELL, M. Inst. C.E., City Engineer.

Guildhall, Hull,
22nd June, 1923. 2793

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—

STEEL WORK FOR BRIDGES (Approx. 171 Tons).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Bridgework," must be left with the undersigned not later than Twelve Noon on Friday, the 6th July, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W. 1,
14th June, 1923. 2770

PUBLIC NOTICES

City and County of Kingston-UPON-HULL.
WATERWORKS.
DUNSWELL PUMPING STATION.
CONTRACT NO. 3.

The Water and Gas Committee of the Corporation of Kingston-upon-Hull invite TENDERS for the CONSTRUCTION of the UNDERGROUND WORKS required at the new pumping station at Dunswell, in the East Riding of Yorkshire.

The works consist of a Well and 17 Shafts sunk through drift into the chalk, 4600ft. of Adits driven horizontally in the chalk at a depth of 90ft. below O.D., and 8 Bores sunk to a depth of from 500ft. to 1000ft. The quantity of water to be raised from the workings during construction will probably exceed 15 million gallons a day.

The drawings may be inspected and specifications, schedule of quantities and form of Tender obtained on application to the undersigned. A deposit of Five Pounds in Bank of England or Treasury notes is required and will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Dunswell Works," are to be addressed to the Chairman of the Water and Gas Committee and delivered at the Town Clerk's office not later than Wednesday, 11th July, 1923.

By Order,
CHARLES B. NEWTON, Engineer.

Guildhall, Hull,
7th June, 1923 2816

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. TENDERS for the SUPPLY of—

(1) STEEL RAILS and FISHPLATES,
(2) BOGIE CARRIAGES,

for No. 1 on Wednesday, the 11th July proximo, and for No. 2 on Wednesday, the 18th July proximo.

Copies of the specifications can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE, Secretary.

73-76, King William-street, London, E.C. 4,
21st June, 1923. 2820

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

	Fee for Specification.
1. MILD STEEL BARS, SECTIONS, &c.	£1
2. MANTLES FOR LAMPS	5s.
3. WICKS, &c.	5s.
4. INDIA-RUBBER HOSE PIPES, SHEETS, &c.	7s. 6d.
5. PAINTS, DRYSALTERIES, &c.	10s.
6. CARRIAGE DOOR HANDLES, HINGES, &c.	7s. 6d.
7. LAMP GLASSES, &c.	2s. 6d.
8. EXPANDED METAL	2s. 6d.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Mild Steel Bars, Sections, &c.," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 3rd July, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE, Secretary.

Company's Offices,
48, Cannon-street, E.C. 2,
London, 20th June, 1923. 2809

PUBLIC NOTICES

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for :—

SPARE PARTS for CARRIAGES and WAGONS (BUFFERS, &c.), Broad and Metre Gauges, in accordance with the specification which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 10th July, 1923, and marked "Tender for Spare Parts for Carriages and Wagons."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1,
19th June, 1923. 2805

Metropolitan Borough of SHOREDITCH.
ELECTRICITY SUPPLY DEPARTMENT.

The Council invite TENDERS for the SUPPLY, DELIVERY, ERECTION, &c., of the following PLANT :—

ONE WATER-TUBE BOILER of not less than 40,000 lb. evap. cap.
TWO SUPERHEATERS.
COAL BUNKERS and CONVEYING PLANT.
ONE 1500 K.W. CONVERTER.

Specifications, drawings, and forms of Tender may be had upon application to the Borough Electrical Engineer, Electricity Supply Department, Coronet-street, Shoreditch, N. 1, on payment in each case of £1 1s., which will be refunded upon receipt of a bona fide Tender.

Sealed Tenders, forwarded in accordance with the instructions given with each specification, are to be delivered not later than Noon on Wednesday, the 4th July, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

C. NEWTON RUSSELL, Borough Electrical Engineer.

Coronet-street,
Shoreditch, N. 1. 2784

State Electricity Commission OF VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY of the following MATERIAL for the Morwell Power Scheme.

Copies of Tender form and specification, &c., will be available for inspection and purchase upon application to

The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 22/98.—TRANSFORMERS.

CHARGE.—10s. for two copies of Tender form, specification, contract conditions, &c., complete. This charge will be returned on receipt of a bona fide Tender.

A third or any further copies will be supplied for the sum of 5s. each, but this charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is required to be lodged with each Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed forms, properly addressed and endorsed, must be delivered to the undersigned in Melbourne not later than Noon, 25th August, 1923.

R. LIDDELOW, Secretary.

State Electricity Commission of Victoria,
Melbourne, Victoria,
2798 Australia.

Surrey County Council.
HIGHWAYS AND BRIDGES DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of a FIRST ASSISTANT ENGINEER, who is required to be a corporate member of the Institution of Civil Engineers, to have had a thorough experience in surveying, preparation of drawings, specifications, and quantities for Road and Bridge Construction, and in the Repair of Roads, particularly in the use of asphaltic materials, and not over 40 years of age.

The appointment will be ranked as an officer of the third class, carrying a salary commencing at £395 per annum, rising by annual increment, subject to approved service, of £15 to £500, and will be an established post under the Council's Superannuation Scheme. It will be determinable at the pleasure of the Council at three months' notice in writing on either side, and be subject to the Standing Orders of the Council relating to whole-time duty, travelling and subsistence allowances and other conditions of the service.

Applications should be forwarded to the County Surveyor at the underwritten address on or before the 28th day of June, 1923.

T. W. WEEDING, Clerk of the Council.

County Hall, Kingston-upon-Thames,
June, 1923. 2769

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PUBLIC NOTICES

Municipal Corporation of RANGOON.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT WATER and SEWERAGE ENGINEER to the Municipal Corporation of Rangoon.

AGE.—Preferably between 30 and 35 years.

QUALIFICATIONS.—Candidates should hold one of the following qualifications :—

Associate Member of the Institution of Civil Engineers or a degree in engineering of any University recognised by the Institution of Civil Engineers as exempting candidates from entrance examination for associate membership.

EXPERIENCE.—It is essential that candidates should have had considerable experience in the design, construction and management of works of water supply, including that of heavy pumping machinery, sewerage systems with tidal and other outfalls, and sewage disposal works. It is also desirable that candidates should have had experience in the general administration of a Municipal Engineer's office.

SALARY.—The grade of the appointment is fixed at Rs. 500 per mensem, rising by annual increments of Rs. 50 per mensem to Rs. 1000 per mensem, in addition an overseas allowance of Rs. 150 per mensem and motor car allowance of Rs. 150 per mensem. The Corporation are prepared to advance, if desired, a sum equal to four months' salary to assist in the purchase of a motor car. The initial salary of the appointment may be fixed up to a maximum of Rs. 1000 per mensem, plus Rs. 300 on account of motor car and overseas allowances in accordance with experience and further qualifications. Other things being equal, preference will be given for approved war service.

AGREEMENT.—The gentleman appointed will be required to pass a medical examination by a doctor nominated by the Corporation and to enter into an agreement in the first case for a period of five years, subject to a probationary period of one year included in the foregoing period. During the probationary year three months' notice terminating the appointment may be given and received. Full first-class passage to Rangoon by Bibby Line will be paid and half salary during passage and similar passage paid if leaving Rangoon within three months of satisfactory termination of appointment. Leave and leave allowances in accordance with the Indian Service leave rules of the Government of India.

The officer appointed will be eligible to subscribe to the Municipal Provident Fund after being confirmed in his appointment; subscriptions are payable at the rate of 8 1-3 per cent. of salary and an equal amount is contributed by the Corporation. Compound interest is allowed according to the amount earned by the Fund, usually 5 per cent. No exchange compensation allowance will be allowed.

Applications, stating age, qualifications, list of appointments held, together with the salaries thereof, if employed, whether married or single, and accompanied by copies of not more than three recent testimonials, will be received up to Noon on the 28th of July, 1923, by the undersigned, from whom further particulars may be obtained.

OGILVY GILLANDERS and CO.,
Agents to the Municipal Corporation of Rangoon.
Reference R. 3216.
2746 67, Cornhill, London, E.C. 3.

SITUATIONS OPEN

WANTED, an ASSISTANT TURBINE DESIGNER, to Assist Chief Engineer of well-known Steam Turbine Builders. Previous experience of "Impulse" Turbines essential, and must be qualified trained mans State age, previous experience, and salary required.—Address, P767, The Engineer Office. 2767 A

WANTED, ASSISTANT, Qualified to Survey Large Factory Establishment Lay-out Dimension and Estimate Capital Cost of Installing and Operating Expenses of Heating Plant for Building and Process Heating on low-pressure feed with vacuum return system. Experience, qualifications, and wage expected. —Address, "HEATING," Wm. Porteous and Co., Advertising Agents, Glasgow. P7574 A

WANTED, Competent GENERAL ENGINEER, able to do Draughting.
Address,
2801, The Engineer Office. 2801 A

WANTED, a First-class MECHANICAL ENGINEER, to Take Charge of a London Office whose chief business is Heating, Ventilating, and Domestic Engineering. The gentleman would have to be of good presence, ability and address, able to interview clients, and one able to carry out large installations, power plants, &c. Applicants to state age, experience, salary required. All applications will be treated in confidence.
Address, P7626, The Engineer Office. P7626 A

WANTED, ENGINEER with Electrical and General experience, for Assistant Position with British Firm of Engineers in India. Applicant must be of good address and unmarried. Apply in first instance by letter, stating in full qualifications and previous experience, also salary required.—Address, P7640, The Engineer Office. P7640 A

ASSISTANT REQUIRED in Water Engineer's Office for waterworks 6th South Coast of England. Must be a good Surveyor, Leveller and Draughtsman, possessing technical knowledge and have had experience in Distribution Department. Age about 25.—Write, giving full particulars and salary required, to Z. M. N. O., care Deacon's, Leadenhall-street, E.C. 3. 2794 A

ENGINEER REQUIRED at the Royal Aircraft Establishment, South Farnborough, to Assist in Aerodynamic Experimental Work upon Aeroplanes in flight. Applicants must have had training in engineering science to the standard of B.Sc. degree and experience in works and drawing-office. Must be willing to fly as observer and be medically fit for flying. Salary from 60s. per week plus Civil Service bonus (total remuneration at present £4 17s. 9d.) to 80s. per week plus Civil Service bonus (present total remuneration £6 4s. 4d.). Preference will be given to ex-Service men.

Application should be forwarded to the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough. 2815 A

METALLURGIST.—CHIEF ASSISTANT WANTED for Engineering Works. Thorough training in Chemistry and Metallurgy essential, with practical experience of Iron and Bronze Foundry Practice.—Give full particulars, together with age and salary required, to ALFRED HERBERT, Ltd., Edgwick Works, Foleshill, Coventry. 2687 A

YOUNG ASSISTANT ENGINEER (Single) WANTED for Icemaking and Cold Storage Plant, with good prospects for the right man.—Address, stating age and experience, 2786, The Engineer Office. 2786 A

WANTED IMMEDIATELY, Capable DRAUGHTSMAN, with experience in up-to-date Steam Turbine design. State previous experience and age and also salary expected.—Address, 2788, The Engineer Office. 2788 A

WANTED for a Well-known Firm of Engineers, a DRAUGHTSMAN, with experience in High-lift Turbine Centrifugal Pumps. Applicants to give full particulars of previous experience and to state age and salary expected.—Address, 2789, The Engineer Office. 2789 A

WANTED, Capable DRAUGHTSMAN, Experienced in Coal Screening and Washing Plant. Able to prepare schemes and carry them through. State age, experience, salary required, and when at liberty.—Address, P7627, The Engineer Office. P7627 A

CONSTRUCTIONAL STEEL DRAUGHTSMAN.—WANTED in London, DRAUGHTSMAN for Design and Detail of Constructional Steel Work under the London Building Acts and the L.C.C. (General Powers) Act, 1909, for steel-framed buildings.—State age and salary.—P7633, The Engineer Office. P7633 A

DRAUGHTSMEN, Railway Carriage and Wagon.—Apply (letter only), stating age, experience, and salary, METROPOLITAN CARRIAGE CO., Saltley, Birmingham. 2803 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED, with Good experience in Locomotive, Carriage and Wagon Work and Internal Combustion Engines. Apply, stating age and qualifications, to the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, W.C. 2. 2778 A

DESIGNER WANTED, with Experience of Combination Turret Lathes.—Apply by letter to H. W. WARD and CO., Ltd., Selly Oak, Birmingham, giving age, particulars of experience, and salary required. 2792 A

DRAUGHTSMEN, SENIOR and JUNIOR, REQUIRED, with knowledge of Motor Car and Engine Design.—Address, P7622, The Engineer Office. P7622 A

DRAUGHTSMEN WANTED; Required for Steel Caissons, Dock Gates, and Heavy Opening Bridges. Only men who have actually been recently engaged upon the design and detail drawings of such work need apply.

Applications, stating age, salary required, and full particulars of training and experience and when at liberty, to STAFF MANAGER, Port of London Authority, Trinity-square, E.C. 3. 2775 A

FOREMAN (HEAD) WANTED for Machine and Erecting Shop of General and Colliery Engineers, accustomed to piecework or bonus rate fixing, methodically progressing work through shop and working to delivery dates; only experienced men giving fullest particulars, age, wage, experience, references entertained.—Address, 2794, The Engineer Office. 2794 A

FOREMAN, with Extensive Experience in Well and Trial Hole Borings, REQUIRED for about 9 months at Singapore.—Write, stating age, experience (at home and abroad), salary required, and full particulars, with copies of not more than three testimonials, to Box No. 893, c/o White's, 33, Fleet-street, London, E.C. 4. 2710 A

REQUIRED, FOREMAN PATTERNMAKER, Used to highest class wood and metal pattern work and up-to-date methods; not over 35.—Address, P7639, The Engineer Office. P7639 A

SITUATIONS WANTED

ADVERTISER (46), Successful as Works and general manager with responsible firms, SEEKS suitable POST. Wide commercial and technical experience, accustomed to take entire control. Good organiser, salesman and progressive man. Would work up stagnant business.—Address, P7591, The Engineer Office. P7591 B

BUYER (38), with Thorough Technical Knowledge of mechanical and electrical engineers' stores, metals, tools, works requisites and machinery; systematical organiser, with initiative, accustomed to handling substantial contracts; wide knowledge of markets.—Address, P7632, The Engineer Office. P7632 B

CONVEYING MACHINERY (Not Pneumatic).—The SERVICES of First-class LONDON REPRESENTATIVE (30) will be AVAILABLE SHORTLY. Advertiser has own connection and handles schemes throughout.—Address, P7636, The Engineer Office. P7636 B

ENGINEER (34) DESIRES POST as Assistant Works Manager or Engineer; sound general engineering and D.O. experience, structural work, steam and pipe work lay-out, gas producers, furnaces, chemical plant; good organiser and used to control.—Address, P7609, The Engineer Office. P7609 B

MECHANICAL ELECTRICAL ENGINEER, Having completed contract with consulting engineers, DESIRES RE-ENGAGEMENT, home or abroad. College and university training, premium apprenticeship, large experience in engineering works methods, power station design and construction, sub-stations, transmission lines, compressed air, colliery work, special engineering experience during the war, accustomed to handle men. Would accept Junior Partnership in well-established engineering or consulting business.—Address, P7624, The Engineer Office. P7624 B

OIL FUEL INSTALLATIONS, MARINE AND COLD STORAGE PLANTS.

SUPT. ENGINEER (A.C.M.S.) DISENGAGED.
Address,
P7635, The Engineer Office.
P7635 B

PUPIL.—APPRENTICESHIP WANTED by Ex-Service graduate, civil engineer or P.W. contractors. Good draughtsman, surveyor, mechanical experience. Moderate terms. South Lanes.—B. ENG., 25, Westdale-road, Rock Ferry, Ches. P7642 B

REINFORCED CONCRETE.

ENGINEERS, CONTRACTORS and OTHERS in difficulties over R/C Problems or wishing Technical Assistance in Design or Execution should write P7503, The Engineer Office.
Expert help and advice will then be forthcoming. P7503 B

DRAUGHTSMAN WANTS SITUATION with Consulting Engineers, Large Manufacturing Concern, or position where a wide experience of mechanical, electrical, and structural work is desirable.—Address, P7620, The Engineer Office. P7620 B

DRAUGHTSMAN (22), with 7 Years' Sound General engineering drawing-office experience, SEEKS ENGAGEMENT on any type of work. Also good knowledge amateur radio work.—"N.," 11, Carden-road, S.E. 15. P7647 B

DRAUGHTSMAN (23), 4 Years' Experience, DESIRES POSITION; used to general lay-out and details of machines; willing to go anywhere.—Address, P7623, The Engineer Office. P7623 B

DRAUGHTSMAN (27), Experienced, DESIRES SITUATION in Auto. or Gen. Engineering Firm. Tech. education, neat and capable designer; salary secondary consideration.—H., 43, Bourk-rd., Willesden. P7641 B

HEAD DRAUGHTSMAN.—POST DESIRED by capable engineer with many years' D.O. and works experience mech. and elect.—Address, P7622, The Engineer Office. P7622 B

JUNIOR DRAUGHTSMAN, Good Tech. Educ., 4 yrs. pupil apprentice, final 6 mths. D.O., SEEKS SITUATION as above. Salary secondary consideration.—C. F. W., 55, King Edward's-gardens, Acton, W. 3. P7625 B

YOUNG MAN (22), Having Served 6 Years, 2 as articled pupil in workshops, drawing-office and test room, with firm of electrical engineers, REQUIRES any POSITION. Excellent references.—JOHN SKINNER, Silverdale, Richmond-road, Twickenham. P7603 B

SITUATIONS WANTED (continued)

WANTED by an Experienced FOUNDRYMAN, POSITION as FOREMAN or WORKING FOREMAN; accustomed to cutlery, locomotive, Sirex, with up-to-date methods of producing castings for all engineering purposes; light or heavy, made in loam, dry and green sand; also repetition machine moulding, &c. Excellent references.—Address, P7592, The Engineer Office. P7592 B

YOUNG ENGINEER SEEKS SITUATION; Jig and tool maker, capstan setter and shop fitter; good experience on small accurate work; excellent references.—Address, 81, King's-road, Henley-on-Thames. P7644 B

ENGINEER FITTER AND ERECTOR; Good Experience with boilers, pumps, shafting, maintenance of plant, &c., control of men; any part of Mainland; moderate salary.—Address, P7645, The Engineer Office. P7645 B

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The Ideal for Efficient Steam Generation.

By DAVID BROWNLIE.

THE recent introduction of practical instruments for the measurement of very large volumes of gases has at last rendered possible the ideal for efficient steam generation—the continuous measurement of the air consumption. A boiler plant is essentially a factory or process equipment for the production of steam at a given temperature and pressure, and the main raw products or ingredients are fuel, water, air, and labour. If we are going to produce steam in the most economical and scientific manner, that is, work the boiler plant at the highest efficiency, it is necessary to keep a continuous and complete record of the labour costs, the amount and analysis of the fuel burnt, the amount and analysis of the water evaporated to steam—that is the production of the plant—and last, but not least, the amount of air used.

Labour costing is, of course, a simple matter, although most firms do not even do this properly. The continuous record of the coal or other fuel consumption is also quite easy, various automatic self-recording coal-weighing machines being on the market. As regards the output of the plant, there are over twenty different feed-water meters and about ten steam meters available, so that here again no difficulty is experienced by anyone who desires to generate his steam on efficient lines. As is of course well known, however, hardly any steam user adopts these obvious methods, even in electricity generating stations, and probably something like at least 90 to 95 per cent. of steam users in Great Britain have no accurate method of determining the output and true performance figures of their boiler plant. The consequence is that, as I have shown on various occasions, the average net working efficiency of the boiler plants of Great Britain is only about 58 per cent., and out of 90,000,000 tons of coal used per annum for steam generation, no less than about 20,000,000 tons is wasted, based on a practicable attainable efficiency of 75 per cent. boiler plant efficiency. One of the great difficulties of maintaining a high figure of 75 per cent. or over is the trouble in connection with the prevention of excess of cold air passing through the fires, and boiler plants in general are at present being worked with the deplorable average of 75 to 100 per cent. excess air, that is, 20 lb. or over of air, or, say, 250 cubic feet at N.T.P. per pound of average semi-bituminous coal as compared with the theoretical figures of, roughly, 11.5 lb. air per pound of steam coal, or, say, 142.5 cubic feet at N.T.P.

This state of affairs is also indicated by the CO_2 figures in the flue gases. In examinations with which I was associated of 400 different steam boiler plants in forty-one different industries, representing 1513 boilers and an annual coal bill of 3,250,000 tons per annum, during the last twelve years or so we carried out about 400,000—four hundred thousand—determinations of CO_2 by means of CO_2 recorders, and the average percentage of CO_2 was found to be 7½ per cent., the plants being grouped as follows :—

CO_2.	Number of plants.	Figure expressed as a percentage.
12 per cent. and over	10	2.5
11 per cent.	10	2.5
10 per cent.	39	9.75
9 per cent.	48	12.0
8 per cent.	60	15.0
7 per cent.	91	22.75
6 per cent.	58	14.5
5 per cent.	51	12.75
Less than 5 per cent.	27	6.75
	394*	98.5

* Six plants in which the figures were not reliable.

From the point of view of CO_2 only, 7½ per cent. by the usual curves corresponds to 27 per cent. theoretical loss in the coal bill from excess of air, and assuming 12 per cent. CO_2 as a reasonable correct figure in practice, corresponding to 17½ per cent. theoretical loss, the actual saving to be obtained in the coal bill by increasing the percentage of CO_2 from 7½ to 12 per cent. would be about 9½ per cent. That is, excess air on this basis alone is costing Great Britain something like 9,000,000 tons of coal per annum wasted in boiler houses.

The percentage of CO_2 in the flue gases as given by the ordinary CO_2 recorder is, however, a very uncertain guide to boiler plant efficiency, and much more information is needed. As we gradually reduce the excess air in the furnace, the percentage of CO_2 is increased in some corresponding proportion until we get to a point where CO and unburnt gases appear in spite of the presence of actual excess air. This points depends in practice on various conditions, chiefly the quality of the coal, but roughly it is about 14 per cent. CO_2, which is equivalent to a 15½ per cent. theoretical loss in the coal bill owing to excess air. If now this figure for CO_2 is put up to 15 per cent. the net result is a loss. The theoretical saving obtained by raising the CO_2 from 14 to 15 per cent. is 1 per cent. of the coal bill (15½ per cent. theoretical loss – 14½ per cent. theoretical loss) but there is at the same time a serious loss of about 7½ per cent. due to CO and unburnt gas, so that the nett result is a loss of 6 per cent. in the coal bill in spite of the reduction in the amount of excess air, whilst a further increase to 16 per cent. CO_2 would give an enormous loss, and 17 per cent. CO_2 is equal to the excess air loss of only 5 per cent. CO_2—33 per cent. theoretical loss. The "critical point of efficient combustion" is given by the highest CO_2 with absence of CO and unburnt gas, and it is obtained with roughly 12 to 17½ per cent. excess air for ordinary coal with mechanical stokers or hand firing.

The use of the most modern type of automatic flue gas analysing machines, therefore—either machines for determining both CO_2 and CO and unburnt gases continuously and giving a record of the results side by side on the same chart, or for determining both CO_2 and oxygen—are much more valuable than the ordinary CO_2 recorder, and will ultimately render the latter obsolete. But even duplex instruments in themselves are not sufficient, and what is really required is to enclose the whole boiler plant and admit the air under just as good control and measurement as the fuel and the water. There is no practical objection to this plan from the point of view of the building, especially in the modern power station plant, for the whole installation can be enclosed so that all the air required enters through one central trunk or shaft. The doors can be of the double variety so as to be absolutely air-tight when the attendants pass in and out for the coal when entering, and for the ash and clinker when leaving. In this trunk may be placed a modern type of large volume metering appliance. The average gas meter type of apparatus through which all the air would pass, is, of course, hopeless because of the size and expense, whilst a velocity instrument with a revolving disc or wheel is not accurate.

The principle now being used is that of the "Pitot" tube or "Venturi" disc, according to circumstances, as in steam meters. The slight difference in pressure, proportional to the volume of air flowing in the "Pitot" tube circuit, or in the neighbourhood of the disc of slightly reduced internal diameter, is recorded by a suitable recording mechanism in terms of cubic feet of air, which must be corrected for temperature and barometer. There is no difficulty about this correction, as the volume of air to be measured is not particularly great in comparison with the volumes involved when measuring the output of blast-furnace gas or the air currents of an entire colliery. Thus, for example, in a large power station plant of, say, ten boilers of 60,000 lb. evaporation per hour each, the total volume of air passing into the station would be about 250,000 cubic feet per minute. The advantage of the "Pitot" tube or the "Venturi" disc principle is that the size of the recording mechanism is independent of the volume to be measured.

In this way, for the first time we should get a boiler plant completely under scientific control, with a record of air and the fuel supplied and the water evaporated. It is tolerably certain that when this is done, many valuable facts will be discovered with regard to the air question, the relations between volume of air, composition of fuel, furnace temperature, complete analysis of the flue gases, and the net working efficiency of the plant, the result of which will be to increase the efficiency of steam generation. There is no reason also why the whole of the exit gases passing up the chimney should not be measured in the same way, if only as a test of the air leakage on the plant. One can only hope that pioneer work of this character will be undertaken in Great Britain, especially since the United States are now decidedly ahead of us in modern methods of boiler and power plant control as applied to power station work.

At present very little is definitely known about excess air, but it is generally believed that the latest type of mechanical forced draught and mechanical stoker for water-tube boilers will operate with 35 to 40 per cent. excess air, although presumably this figure is based largely on calculation, and not on actual determination. As typical of the latest practice in this respect, there is a certain new boiler plant projected in this country with "Babcock and Wilcox" water-tube boilers of 8619 square feet heating surface. Each boiler is to evaporate 60,000 lb. per hour at 210 lb. pressure, and the steam is to be superheated to 677 deg. Fah. in a superheater of 3190 square feet heating surface. The plant will include a special Green "tri-tube" cast iron economiser of 4620 square feet heating surface—with entering feed-water at 180 deg. Fah.—and an "Usco" air heater. The stokers are to be of the "Underfeed" travelling grate design, "Type A." The guaranteed efficiency of this plant is 85 per cent. on the lower heating value of the coal, or deducting the power used for the mechanical draught—forced and induced draught fans—and mechanical stoker, about 88 to 88½ per cent., according to ordinary methods of calculation.

Apart from the fact that the whole question of boiler plant testing is in hopeless confusion and no proper test code exists, so that it is difficult to say what these figures actually mean, it is obvious that the above is a very high guarantee and involves the use of only about 37 per cent. excess air. This figure corresponds to 1,273,000 cubic feet of air at N.T.P. per hour, or 162.8 cubic feet per pound of coal burnt, as the coal consumption is to be 7816 lb. per hour. The coal, it may be stated, is of somewhat moderate quality, giving 10,800 B.Th. U. on the lower heating value—whatever that means exactly—for the method of expressing the heating value of fuel is part of the general confusion.

The best results with regard to excess air are, of course, obtained with pulverised fuel, because of the intimate mixture obtained with the air and the fuel owing to the fine state of division of the latter. The most elaborate tests have been carried out in the United States by Henry Kreisinger at the famous "Lakeside" installation of the Milwaukee Electric Railway and Light Company, which consists of eight "Edge-Moor" water-tube boilers with superheaters and economisers working at 300 lb. pressure and fired by the "Lopulco" system of pulverised fuel, supplying 40,000 kilowatts. The figures of this boiler plant represent one of the most remarkable performance for steam generation in the world, averaging, according to Mr. Kreisinger, 85 to 86 per cent. efficiency, and the air figures—which were determined only with great time and trouble—are as follows for five typical tests at different loads on the boiler :—

Tests on One Boiler, Normal Duty 85/90,000 lb. per Hour.

Duty of boiler, evaporation in pounds per hour, average..	53,390	83,953	81,121	57,572	92,202
Air—					
(a) Temperature entering furnace, deg. Fah.	86	89	91	104	93
(b) Pressure of air at pulverised fuel feeders, inches W.G.	11.0	12.2	13.6	12.2	13.6
(c) Excess air in flue gases, per cent.	13.3	21.9	21.2	10.7	25.2
Flue gas—					
(a) CO_2 in fourth pass, per cent.	15.8	14.6	14.7	16.0	14.1
(b) O_2 in fourth pass, per cent.	3.3	4.6	4.6	3.3	5.2
(c) CO in fourth pass, per cent.	0.05	0.00	0.03	0.00	0.09
(d) Pounds dry gas pound coal, per cent...	11.04	11.63	11.37	10.06	11.56
(e) Temperature leaving boiler, deg. Fah.	434	475	482	430	496
(f) Temperature entering economiser, deg. Fah.	338	400	424	400	431
(g) Temperature leaving economiser, deg. Fah.	168	196	205	204	251
Draught—					
(a) At furnace, inches W.G.	0.017	0.19	0.16	0.045	0.206
(b) At fourth pass, inches W.G.	0.314	1.11	1.185	0.39	1.40
(c) Entering economiser, inches W.G.	0.424	1.23	1.28	0.40	1.66
(d) Leaving economiser, inches W.G.	0.525	1.67	1.72	0.51	2.38
Pounds water evaporated per pound of coal	8.92	8.62	8.49	8.66	8.12

The figures, therefore, for excess air vary from 10.7 to 25.5 per cent. excess over the theoretical, rising as the plant is forced, a very fair average for pulverised fuel being 20 per cent. excess, corresponding to 16 to 17 per cent. CO_2 at the actual point of combustion, although here again the methods used are not very clear.

Spiral Bevel Gears.

By W. C., D.

No. I.

As the name signifies, the spiral type bevel gear has teeth that, instead of being straight as in an ordinary bevel gear, are curved, closely approximating a spiral. This type of gear has been adopted to a very large extent for the final drive in rear axles of automobiles by motor car manufacturers. For many years there has been a considerable amount of discussion as to the best type of final drive, each type possessing certain advantages, but the reason that the spiral type has come into favour during the last two or three years is that it is claimed to be more silent than others, and in the quest for silence manufacturers have spent considerable time and money. It is somewhat difficult, however, to obtain straight tooth bevels with a high degree of silence. The disadvantage of the spiral bevel is the end thrust, which is considerably more than with straight-tooth bevels, but if the spiral angle of the teeth is not made more than 35 deg., then no trouble will arise if a double ball thrust of ample proportions be provided.

PRINCIPLES OF SPIRAL BEVEL GEARS.

As already indicated, the curve of the teeth of spiral bevel gears only approximates a spiral, the reason being that to make their production possible the teeth are generated by rolling the gear blank and using a revolving circular face-cutter. Hence, the actual curve of the teeth when developed in a

plane is not a true spiral, but very closely approaches such a curve, and since there would be no advantage in obtaining a true spiral curve, this approximation is quite permissible, and does not involve manufacturing difficulties which would be presented if the perfect curve were sought.

The pinion and gear have a common apex point, so that they mesh with a true rolling action, no sliding action taking place.

In Fig. 1, a typical pair of spiral bevel gears is shown, from which it will be seen that the teeth overlap by an amount which is governed by the spiral angle, and that as a result two or more teeth may be in contact at the same time, which, as in the case of helical gears, promotes quietness and smoothness of operation.

Very few machines for generating spiral bevel gears are built in this country, and in this article it is proposed to deal with the machine made by the Gleason Works of Rochester, New York.

The cutter is illustrated in Fig. 2, and is in the form of a face mill, in which twenty separate blades are inserted, the distance from one blade centre to the one diametrically opposite being 12in. The blades are fitted into notches in the cutter head, and each blade is held in position by means of a wedge and setscrew. Ten blades are fixed to cut on the inside edge of the circle and ten on the outside edge. The axis around which the cutter rotates can be adjusted by suitable slides to any position required for any gears within the capacity of the machine. The whole of the cutter mechanism swings in a semi-circular cradle, and the gear blank is rolled past the cutter by means of a compound gear in harmony with the swing of the cutter. This combination gives the desired generating motion.

The gear blank is automatically drawn away from the cutter as soon as the latter has completed its cut, and the blank is then automatically indexed to the next tooth before it is fed into the path of the cutter. The tools start at the large end of the blank and cut towards the small end. When cutting the mating bevel pinion, the latter will be cut in the reverse direction, that is, from the small end to the large end. The roughing cutters should be the same hand as the spiral on the gear, but the Gleason Company recommends left-hand finishing cutters in all cases.

The gears are "roughed" out by roughing cutters, so that the finishing cutters are only required to take light cuts. Although gears can be roughed and finished on the same machine, special machines, known as roughing machines, are made and are desirable where mass production is required.

When generating spiral bevel gears by the Gleason method, the planing of the bottom of the teeth is dependent on the path in which the tips of the cutter blades rotate, and it is necessary to adjust the blank, so that the required root angle is produced. This setting over of the blank would naturally cause the inside cutter blades to generate a different pressure angle from the outside tools if both sets of blades were bevelled to the same angle, hence the inside and outside cutting edges are ground to different angles. Cutters for producing a 14½ deg. pressure angle, for instance, have the inside blades ground to something greater than 14½ deg., and the outside blades to less than 14½ deg.

From the foregoing it will readily be understood that the amount of spiral that can be given to any gear and pinion is dependent on the root depth of the teeth to be cut and the amount of variation of the cutting angles of the blades from the standard pressure angle.

Spiral Angle.

The spiral angle is measured at the centre of the face of the tooth on the pitch line, and is the angle between a line tangential to the curve of the tooth at its centre point; therefore, the spiral angle will be greater at the large end of the tooth and less at the small end, but it is the spiral angle at the centre which is used to define the spiral angle of the gears. To obtain the best results, the spiral angle should be such that one tooth overlaps the next one; in other words, the amount of spiral or lead should be 1¼ to 1½ times the circular pitch, so that one tooth is well in mesh before the preceding tooth is out of gear. This can sometimes be arranged by varying the width of the face, or provided the gears are not overloaded, the pitch may be made fine, which has the advantage of giving a better roll.

Fig. 3 illustrates the meaning of "spiral angle," from which it will be seen that it is the angle subtended at the centre of the face between a line drawn to the cone apex and a tangent to the tooth curve. The Gleason Company recommends that this angle should be as near as possible to 30 deg., but should not, in any case, exceed 35 deg. The spiral angle is also governed by one other condition, that is, the root depth of the teeth below the pitch line, and the amount of variation of the cutter blades from 29 deg. The Gleason Company gives the following formula for finding the spiral angle which the various cutters will provide, viz.:—

Sine pitch line spiral angle = Variation in minutes divided by the sum of the block angle of both gear and pinion, also in minutes.

Hand of Spiral.

The hand of the spiral should be such that in the forward direction of rotation of the gears the convex side of the teeth is the advancing or driving face. A right-hand spiral is one which follows the direction of a right-hand screw thread. For a pair of gears to mesh it is necessary for the wheel and pinion to be of opposite hands, *i.e.*, a pinion with a left-hand spiral should mesh with a right-hand spiral wheel, and when describing, say, a left-hand pair of gears it is understood that the pinion has a left-hand spiral and a right-hand pair of gears the pinion has a right-hand spiral.

Driving Load.

The tooth pressures are considered as concentrated at the centre point of the tooth, which coincides with the mean pitch circle in the common axis plane. The transmitted load is tangential to the mean pitch radius, while the total load is normal to the tooth. Referring to Fig. 3, if P equals the tangential load in either forward or reverse direction, then P_a will represent the direction and total load normal to the spiral angle of the tooth. Owing to the obliquity or pressure angle of the teeth P_a has another resultant P_r acting at an angle equal to the pressure angle A of the teeth. There are four possible conditions of spiral bevel gears, viz.:—

(1) Left-hand spiral pinion rotating clockwise.
(2) Left-hand spiral pinion rotating counter-clockwise.
(3) Right-hand spiral pinion rotating clockwise.
(4) Right-hand spiral pinion rotating counter-clockwise.

Fig. 4 is a diagrammatic view of a typical pair of spiral bevel gears which illustrates the various pressures and the direction of action, from which it will be seen that P_a has a horizontal component N along the pitch cone angle, and that P_n has a horizontal component N_B at angle U from N_B. These two horizontal forces N and N_B have horizontal components T_r and T_e acting parallel to the axes of the pinion and gear respectively. The two components T_r and T_e represent the final end thrusts and the arrows indicate the direction of these forces on the teeth of the gear; therefore the forces acting on the teeth of the pinion will be in the opposite direction. The pair of gears shown in Fig. 4 comprises a left-hand spiral pinion and right-hand spiral gear, the pinion rotating clockwise, this being a typical example of a rear axle drive as generally used in automobile work. It will be noted that the end thrusts T_r and T_e in this case tend to force the gears out of mesh. When the gears are driven in the reverse direction the end thrusts will tend to draw them further into mesh, thus necessitating the use of a double thrust bearing behind the pinion.

In the case of a right-hand spiral pinion rotating clockwise the end thrusts will tend to draw them further into mesh as in the case of a left-hand spiral pinion rotating counter-clockwise, whereas with a

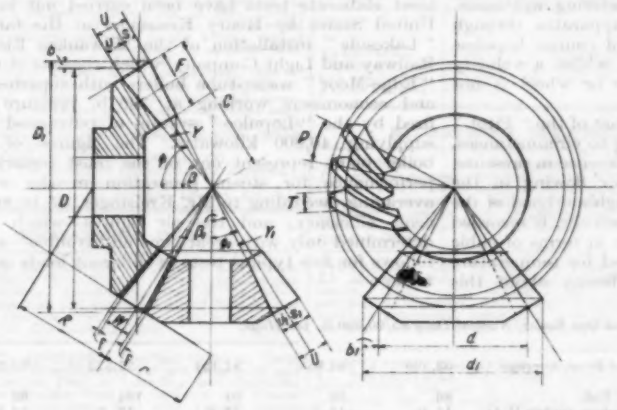

Fig 1 Typical Layout of Spiral Bevel Gears.

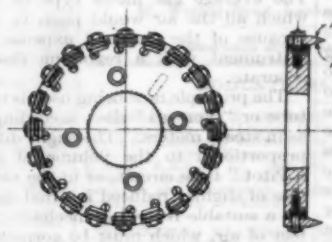

Fig 2 Elevation and Cross Section of Finishing Cutter for Gleason Spiral Bevel Gear Generator.

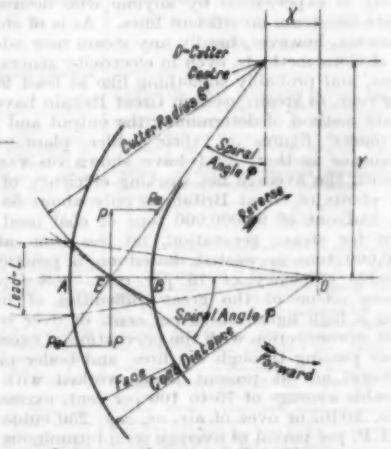

Fig 3. Diagram of Right-Hand Spiral Gear, Illustrating Spiral Angle, Lead, Rough Cutter Setting & Lines of Action of Pressures for Forward & Reverse.

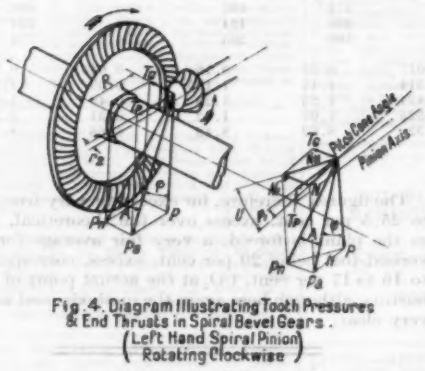

Fig. 4. Diagram Illustrating Tooth Pressures & End Thrusts in Spiral Bevel Gears. (Left Hand Spiral Pinion Rotating Clockwise)

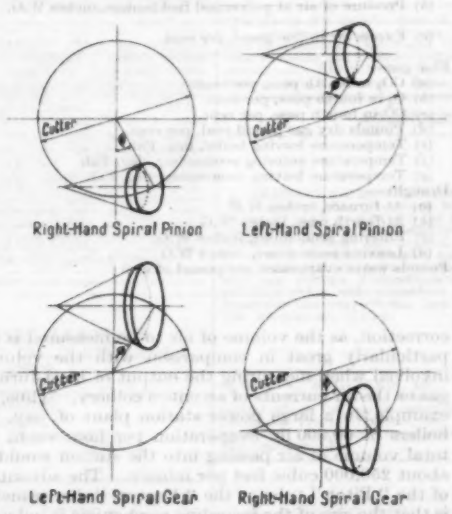

Fig. 5 Showing Position of Blanks in Relation to Cutter For Different Hands of Spiral

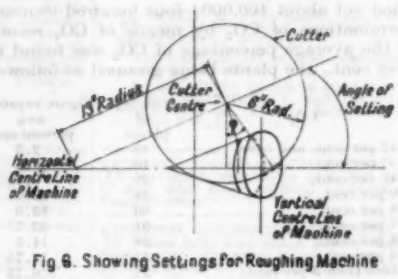

Fig 6. Showing Settings for Roughing Machine

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right-hand spiral pinion rotating counter-clockwise the end thrusts tend to force the gears out of mesh as in the case of a left-hand rotating clockwise.

The formula for calculating the end thrusts necessitates the use of elementary trigonometry, and as an example the case of a left-hand spiral pinion rotating clockwise will suffice to show the method of procedure. Referring to Fig. 4,

Let

P = Force tangential to mean pitch circle of pinion in pounds.
P_e = Force normal to the tooth spiral angle.
P_n = Force normal to area of tooth contact.
N = Horizontal component of P_n.
N_H = Horizontal component of P_n.
T_r = Final end thrust parallel to pinion axis.
T_g = Final end thrust parallel to gear axis.
θ = Spiral angle.
A = Tooth pressure angle.
φ_1 = ½ included pitch cone angle of pinion.
H P = Horse-power transmitted.
r_2 = Mean pitch radius of pinion in inches.
S = Speed of pinion in revolutions per minute.
T = Torque in lb. inches.

Then

$$T = \frac{H P \times 33{,}000 \times 12}{2 \pi S}$$

$$P = \frac{T}{r_2}$$

$$P_e = \frac{P}{\cos \theta}$$

$$N = P \tan \theta.$$

$$P_n = \frac{P_e}{\cos A}$$

$$N_H = \frac{N}{\cos U}$$

Where U is the angle in the plane of axes between the direction of N_H and the pinion cone angle through contact point.

Continuing,

$$N_H = \frac{N}{\cos U} = \frac{P \tan \theta}{\cos U}$$

$$T_r = N_H \cos (U - \varphi_1)$$

$$= \frac{P \tan \theta}{\cos U} \times \cos (U - \varphi_1)$$

By trigonometry we have:

$$\cos (U - \varphi_1) = \cos U \cos \varphi_1 + \sin U \sin \varphi_1$$

Then

$$T_r = \frac{P \tan \theta}{\cos U} (\cos U \cos \varphi_1 + \sin U \sin \varphi_1)$$

$$= P \tan \theta (\cos \varphi_1 + \tan U \sin \varphi_1)$$

Referring to the diagram of forces in Fig. 4, it will be seen that

$$\tan U = \frac{N_1}{N} = \frac{\frac{P \tan A}{\cos \theta}}{P \tan \theta} = \frac{\tan A}{\sin \theta}$$

hence

$$T_r = P \tan \theta \left(\cos \varphi_1 + \frac{\tan A}{\sin \theta} \sin \varphi_1\right)$$

$$= P \left(\tan \theta \cos \varphi_1 + \tan \theta \frac{\tan A}{\sin \theta} \sin \varphi_1\right)$$

$$= P \left(\tan \theta \cos \varphi_1 + \frac{\tan A}{\cos \theta} \sin \varphi_1\right)$$

The end thrust T_g parallel to the axis of the gear is determined as follows:—

T_g = component of P_n

$$= N_H \sin (U - \varphi_1)$$

$$= \frac{P \tan \theta}{\cos U} \sin (U - \varphi_1)$$

But since $\sin (U - \varphi_1) = \sin U \cos \varphi_1 - \cos U \sin \varphi_1$, we get—

$$T_g = \frac{P \tan \theta}{\cos U} (\sin U \cos \varphi_1 - \cos U \sin \varphi_1)$$

$$= P \tan \theta (\tan U \cos \varphi_1 - \sin \varphi_1)$$

Since, however,

$$\tan U = \frac{\tan A}{\sin \theta}$$

Then

$$T_g = P \tan \theta \left(\frac{\tan A}{\sin \theta} \cos \varphi_1 - \sin \varphi_1\right)$$

$$= P \left(\tan \theta \frac{\tan A}{\sin \theta} \cos \varphi_1 - \tan \theta \sin \varphi_1\right)$$

$$= P \left(\frac{\tan A \cos \varphi_1}{\cos \theta} - \tan \theta \sin \varphi_1\right)$$

The above values for T_r and T_g are the same for a right-hand spiral pinion rotating counter-clockwise.

In a similar manner, for a left-hand spiral pinion rotating counter-clockwise and a right-hand spiral pinion rotating counter-clockwise, the values for T_r and T_g are:—

$$T_r = P \left(\tan \theta \cos \varphi_1 - \frac{\tan A \sin \varphi_1}{\cos \theta}\right)$$

$$T_g' = P \left(\tan \theta \sin \varphi_1 + \frac{\tan A \cos \varphi_1}{\cos \theta}\right)$$

Lead.—The lead is represented by the distance L measured on the outer edge of the gear or pinion, as shown in Fig. 3, and for all practical purposes may be taken as being equal to the face width multiplied by the tangent of the spiral angle. To ensure more than one complete tooth being in contact at all times, the lead should be more than the circular pitch, and the Gleason Company recommends that the lead should be from 1¼ to 1½ times the circular pitch to give the best results.

Face width.—It is obvious that the amount of lead for a given spiral angle using a cutter of a constant diameter depends upon the face width of the gear, and that the lead is governed by the pitch employed, so that there is a minimum face width that should be used for a given spiral angle.

By using a greater face width the spiral angle can be reduced, but a wider face than necessary for the lead recommended above demands greater perfection of workmanship without any material gain. Moreover, the cutter limits the maximum face width, which, for a standard cutter of 12in. diameter, should never exceed 2in. under any circumstances.

Tooth Form.—The standard tooth standardised by the Gleason Company is the octoid form, having a mean pressure angle of 14½ deg. in the normal section of the teeth. The blades of the cutter are ground as a rack, so that the cutter and gear blank rolling together with a generating motion, as already described, produces a true octoid tooth. Owing to the curved form of the teeth, however, the pressure angle of the concave side is made slightly less than 14½ deg. and slightly greater on the convex side, but as the increase and decrease are equal, the sum of the two angles is always 29 deg.

Tooth Proportions.

Since the cutter blades are in the form of a rack, all metal which would cause interference with the mating gear is cut away from the pinion, thereby causing the teeth to be undercut in many cases, and in order to avoid or reduce this undercutting, the Gleason Company recommends that the maximum working depth of the teeth be made 0.85 of the standard working depth, and that the addendum of the pinion should be 0.7 of its working depth, and the addendum of the gear tooth 0.3 of its working depth. These proportions are not absolutely essential, as in some cases it may only be necessary to make the working depth of the teeth 0.85 of standard depth, making the addenda for both gear and pinion equal, or, in other cases, the standard working depth can be used, making the addenda for the pinion and gear 0.7 and 0.3 proportions respectively. The gears can also be cut to standard proportions, but, as a general rule for automobile work, it will be found that when the teeth have 14½ deg. obliquity, the working depth should be 0.85 of standard based on the linear pitch and the addenda of the pinion and gear made 0.7 and 0.3 of this depth, in order to avoid undercutting.

The clearance at the bottom of the teeth should be, preferably, slightly more than the usual standard, and 0.07 of the circular pitch is recommended, so as to reduce the possibility of the teeth touching on the bottom. All other proportions, such as pitch diameters, cone distance, circular pitch, pitch cone angles, &c., that are not affected by the modified working and pitch depths, are derived in exactly the same manner and by the same formulas as for straight-tooth bevel gears.

Circular Thickness.—When gears are made with corrected addenda, the circular thickness for the gear and pinion will not be the same, and if the addendum of the gear is made 0.3 of its working depth and the pinion 0.7, then the thickness of the teeth on the pitch circumference of the gear will be thinner, while the pinion teeth will be thicker. The circular thickness of the teeth on the pitch circumference for the gear will be equal to half the circular pitch minus twice the tangent of the pressure angle multiplied by the difference between half the working depth and the corrected pitch depth. The circular thickness of the teeth on the pitch circumference of the pinion is equal to half the circular pitch plus the same amount.

Face and Cutting Angles.—These angles are affected by the correction to the angle increment and decrement, otherwise these are determined in a similar manner as for straight-tooth bevels. The same remark applies also to the outside diameters of the gear and pinion.

Methods of Cutting.

There are two methods of cutting spiral bevel gears, viz., the standard or single-side method and the spread blade method. By the standard method each side of both the gear and pinion teeth are cut in separate operations, *i.e.*, one side of all the teeth is cut, then after the cutter and blank have been moved the other sides of the teeth are cut.

When using the spread blade method both sides of each tooth of the gear are cut in the same operation, but the pinion teeth should always be cut by the standard method, because there is no saving in time by cutting the pinion by the spread blade method, whilst there is a distinct saving in so cutting the gear.

Cutters.—For both the standard and spread blade methods of cutting two cutters are used. The teeth are first "gashed" out with a roughing cutter, and completed with a finishing cutter. In both cases the cutters have been standardised to cut both 14½ deg. and 20 deg. mean normal pressure angles. Owing to the curved path of the cutter blade in cutting spiral instead of straight, compensation has to be effected by making the angles of the inside and outside cutting blades slightly above and below the mean pressure angle which it is desired to produce. For instance, to produce a mean pressure angle of 14½ deg., the inside blades are made more than 14½ deg. and the outside made less than 14½ deg.

To obtain the best results a cutter specially corrected in this manner would be required for each ratio of bevel gears to be cut, having a fixed spiral angle, although in actual practice a range of ten cutters has been found to give satisfactory results, and the following range has therefore been standardised:—

Cutter No.	Angle A_1.	Angle A_2.
3½	13° 55′	15° 0′
4½	13° 45′	15° 15′
5½	13° 35′	15° 25′
6½	13° 25′	15° 35′
7½	13° 15′	15° 45′
8½	13° 5′	15° 55′
9½	12° 55′	16° 5′
10½	12° 45′	16° 15′
11½	12° 35′	16° 25′
12½	12° 20′	16° 35′

The above figures are used for finishing-cutters—see Fig. 2—for generating a mean normal pressure angle of 14½ deg.

Roughing cutters are made with point widths ranging from .030in. to .240in. in steps of .010in., while the finishing cutters are made with a standard point width of .060in., except for very fine pitches when special cutter blades are required.

Both roughing and finishing cutters have the following variable characteristics which determine the cutters required:—

Roughing Cutters:—Hand of cutter.
Point width.
Mean pressure angle.

Finishing Cutters:—Cutter No.
Hand of cutter.
Point width.
Mean pressure angle.

Roughing Cutters.—The hand of the roughing cutter is selected as already described, and the mean pressure angle will be the same as that of the finishing cutter. The point width is dependent upon the width of the bottom of the tooth space at the small end, normal to the tooth section, less an allowance which should be left on the teeth for the finishing cuts. The circular thickness of the teeth at the large end on the pitch line should in the first case be determined as already described, then the width of the tooth space in the normal section is found by multiplying the circular thickness at the large end of the tooth by the cosine of the spiral angle at the centre of the face. From this is subtracted the amount by which the tooth space is decreased at the bottom of the teeth owing to the pressure angle or angle of obliquity. This amount is equal to twice the flank depth, *i.e.*, the depth of the teeth below the pitch line, multiplied by the tangent of the pressure angle. The finished width of the tooth space is now obtained at the large end in the normal section.

Since the tooth space at the small end is proportional to its distance from the apex of the pitch cone, the dimension obtained as above should be multiplied by the product of the cone distance minus the face width divided by the cone distance, afterwards subtracting, say, .040in. as an allowance of .020in. on each side of the tooth for the finishing cut.

To avoid the necessity of having to determine the spiral angle at both the large and small end of the teeth, the Gleason Company suggests a deduction of 2½ deg. from the spiral angle at the centre of the face, as covering all the practical requirements. It should be noted, however, that when the modified addenda and dedenda are used the circular thickness of the teeth on the pitch line is not to be the same for the gear as for the pinion; hence there will be two point widths of roughing cutters, one for the gear and one for the pinion. Further, it must be remembered that the width of the tooth space in the gear will be the same as the circular thickness of the pinion teeth, and *vice versâ* for the pinion.

Cutter Settings.—To cut a right-hand spiral on the pinion the cutter centre should be set above the pinion centre, and for the mating gear, which should have a left-hand spiral, the cutter centre should be set below the gear centre. Likewise, to cut a left-hand spiral on the pinion and a right-hand spiral on the mating gear, the cutter centre should be set below and above the pinion and gear respectively, as illustrated in Fig. 5.

Roughing Cutter Settings.—The vertical and horizontal settings of the roughing cutter for a right-hand spiral gear are shown graphically in Fig. 6 and are the distances measured from the cone apex to the centre of the cutter. The vertical setting is equal to the radius of the cutter—viz., 6in.—multiplied by the cosine of the pitch line spiral angle. The horizontal setting is equal to the cone distance minus half the face width of the gear minus the product of the cutter radius multiplied by sine of the pitch line spiral angle.

The above particulars are for the roughing cutter

THE WORKS OF THE INTERNATIONAL COMBUSTION ENGINEERING CO, LTD, DERBY

FIG. 1

settings when the work is done on the finishing machines, but when the gears are roughed out on the roughing machine the same vertical setting as given above holds good, but the horizontal setting is obtained by setting the cutter head at an angle above or below the horizontal centre line of the machine according to the hand of spiral to be produced. The reason for this difference is that the cutter only receives a rotating movement and is carried on an arm which is swung round a fixed centre at an angle to the horizontal dependent upon the radius of the arm and the required spiral angle. This is clearly illustrated in Fig. 6, from which it will be seen that the sine of the setting angle is equal to the radius of the cutter multiplied by the cosine of the spiral angle divided by the radius of the arm on which the cutter is fixed and which is 13in.

Effective Pressure Angle.—Owing to the fact that the cutter blades travel in a circular path along the root line of the gear being cut, the actual effective pressure angle in the normal section is not the same as the pressure angle of the blades; therefore it is necessary to apply a correction angle to the angles of the cutter blades. This correction angle, as specified by the Gleason Works, is obtained by the following formula:—

Tangent correction angle = sine pitch line spiral angle multiplied by tangent of the block angle of the pinion and is applied in the following manner:—

Effective pressure angle for top side of the teeth of both the pinion and gear is equal to the angle of the outer cutter blade plus correction angle, whilst the effective pressure angle for the bottom side of the teeth is equal to the angle of the inside cutting blade minus the above correction angle.

TERMS for the absorption of the Wirral Railway by the London, Midland and Scottish Railway Company have now been agreed.

Derby Works of the International Combustion Engineering Co., Ld.

NEW works have recently been erected at Derby by the above-named company for the construction of Underfeed Stokers. The site chosen for the works adjoins the London, Midland and Scottish branch line from Derby to Melbourne, and is approached from the road which runs from Derby to Ashby. This road forms the western boundary of the company's land, which covers about 53 acres. In the lay-out of the works, the company has paid special attention to the provision of the most efficient transport facilities, both internally and externally, and has had in view the necessity for further extensions at an early date. But, perhaps, the feature which stands out most prominently is the excellent natural lighting of all departments, and especially of the foundry and machine shop. It is quite an easy matter for the architect to introduce plenty of glass into his designs, but it is not nearly so easy for those who have the control of the works to maintain an equable temperature in such structures during all seasons of the year. They are liable to be very cold in winter, and much too hot when the sun is high. It is, moreover, not an easy matter to keep the glazing clean in most cases. Mr. A. W. Farnsworth, M.I. Mech. E., who has been responsible for the design of the buildings in consultation with the directors and manager, claims, however, to have overcome both of these difficulties.

A general plan of the works is given in Fig. 2 and a bird's-eye view in Fig. 1 at the top of this page. Sectional drawings and detail are given in Fig. 3, while in our Supplement some photographic views of various departments are reproduced. It may be explained to begin with that the sidings from the railway are laid out on an easy curve, and that standing sidings and space for their further extension are provided by a turn-out running north and dividing into a number of separate lines. In order to co-ordinate road and rail transport, a roadway has been made across the site from the main roadway on the western boundary. A 60-ton Avery weighbridge is provided for weighing all goods inwards and outwards.

This roadway and the railway siding run parallel and in proximity to each other, giving alternative methods of delivering the supplies of raw material and removing the finished products. The buildings comprise a block of offices—drawing and general—at the entrance from the roadway, a machine shop measuring 226ft. by 150ft., a foundry 262ft. 6in. long by 150ft. span, a pattern shop and pattern store, a boiler-house for the heating apparatus and transformer and switch-houses for dealing with the electric power supplied by the Derby Corporation. The foundry lies east and west, and the machine shop north and south. The two buildings are designed on generally similar lines, and it is claimed that, so far as is known, no workshops in this or any other country have so great an amount of glass lighting per square foot of covered floor area. As an example, the machine shop has a floor area of 33,561 square feet, while the total amount of glazing in the structure is 34,117 square feet. Each of these buildings has one 60ft. span and two 45ft. spans, the centres of the stanchions being spaced 37ft. 6in. apart. The stanchions are composed mainly of two rolled steel joists, 14in. by 6in., braced together and carried on heavy concrete foundations. The side stanchions are composed of two angles, 5in. by 3in., and two other angles, 4in. by 3in., braced together. They are placed 12in. apart, and are 32ft. high to the eaves. The longitudinal sides of the buildings are thus divided into bays 12ft. 6in. long, and except for a height of 6ft. from the floor level, which is of brickwork, these spaces are filled with heavy section Mellowes sashes and glazed. The height of brickwork of 6ft. was chosen so that there should be the minimum of risk of breakage of glass from inside the shops, and for ease in fixing the benches, &c. It is note-

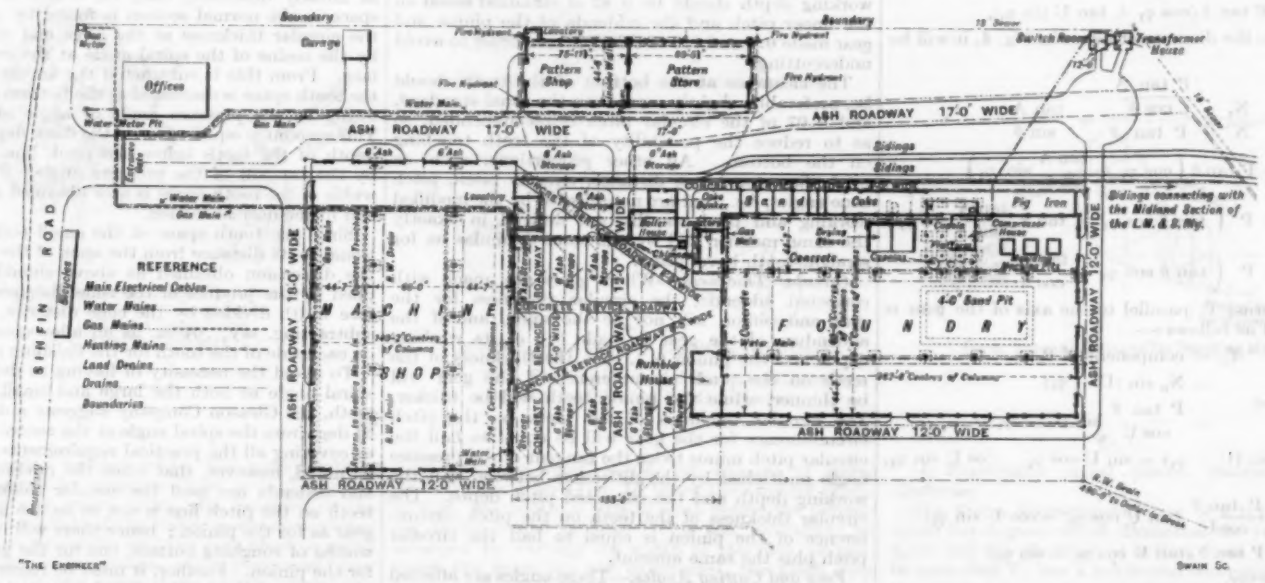


FIG. 2—PLAN OF THE WORKS

worthy that one-half of the roof area is also glass.

As will be seen from the illustration—Fig. 3—all spans are of French truss formation, each span having a large lantern at its apex. In place of louvres in the lantern, swinging sashes controlled by gear at the floor level are provided. One set of Hope's "all-tension" gear operates the sashes on the full length of the lantern, namely, 260ft. Further ventilation is provided by "fall-in" hopper type casements in the glazed sides of the buildings, by which means an upward current of fresh air is maintained throughout the building. Additional ventilation can be given, if necessary, in very hot weather, by means of large sliding doors on the Coburn track system, each with an opening of 12ft. by 15ft. The first impression is that buildings with so much glass in their construction will be excessively hot in summer months, but we are informed that during last summer—which, by the way, was scarcely up to the average as regards temperature—no discomfort was felt by the workers. In fact, inside the building it was generally cooler than in the shade outside.

The heating apparatus for the whole of the buildings comprises four Ideal low-pressure steam boilers, each having a heating capacity of 1,340,000 B.Th.U. Duplicate sets of electrically operated pumps return the water of condensation from the heating pipes to the boilers, from which steam mains are led at a high level into the shops. The steam descends through dropper pipes to batteries of wrought steel gilled pipes placed around the wall under the glazed sashes and inside the main columns. The drainage pipes are placed in channels below the floor. We are informed that with this apparatus a temperature of 60 deg. Fah. can be maintained in the buildings when the outside temperature is 32 deg. Fah.

To provide glazed roofing in factories is one thing, and to keep it clean, especially on the inside, is another. For this purpose, three cleaning gangways have been arranged in each span underneath the roof, so that every part is accessible. These gangways form part of the roof principals, and extend from end to end of the buildings. Access to them is gained by vertical steel ladders up the gable end of each span, and water is laid on to each gangway. To prevent interference with the light, the gangways are made in the form of steel grids with ½in. bars 3in. apart.

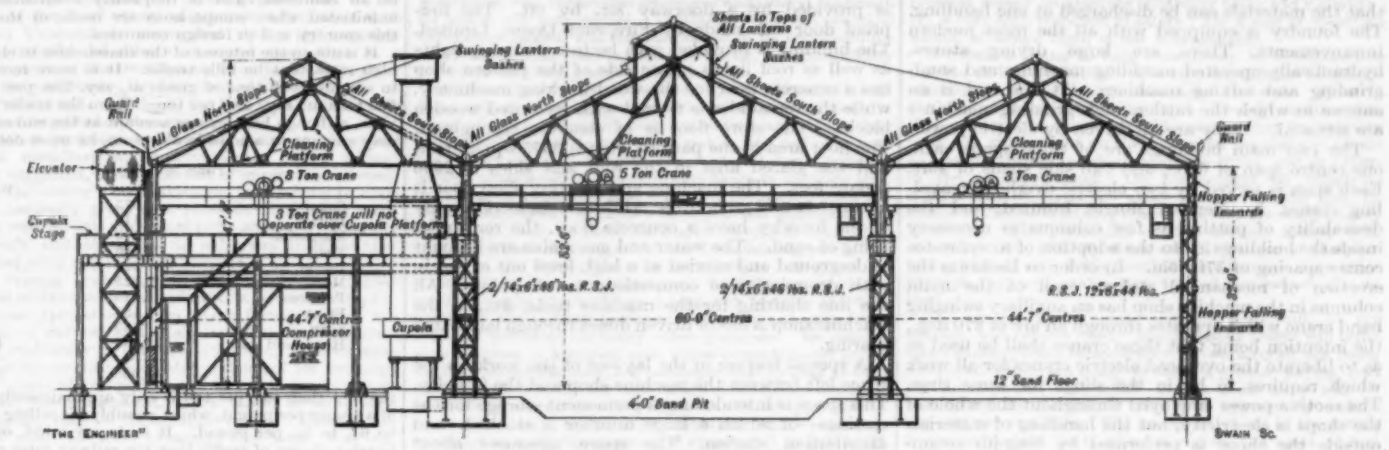


FIG. 3—CROSS SECTION THROUGH THE FOUNDRY

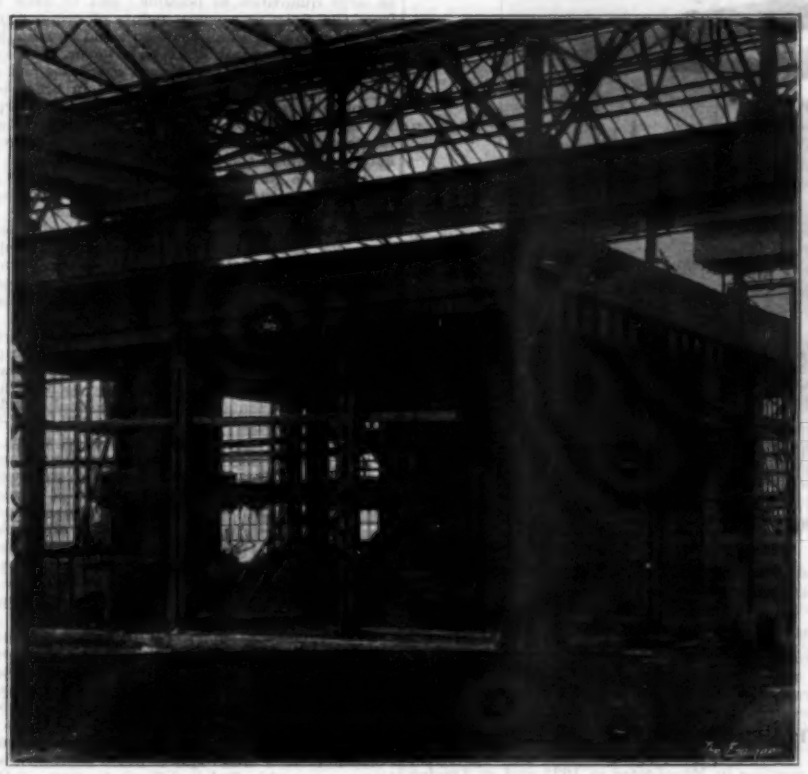


FIG. 4—CUPOLA, CUPOLA STAGE, AND COMPRESSOR HOUSE

The electric cranes in the main buildings are carried on solid web-plate girders attached to the stanchions and braced together to prevent spreading. The tops of the main columns are connected by girders lengthwise of the building, and wind ties are provided both in the roof and sides. One gable end of the building is permanently constructed, but the other is only of a temporary character to enable extensions to be made at a minimum cost. This end framing is complete in itself so that its removal may be effected without stoppage of work in the shops, and is so arranged that a new length of building can be added without interfering with the existing building. The roof covering of all the shops consists of corrugated cement sheeting supplied by the British Fibrocement Works, Limited, and both temporary and permanent gable-ends are covered in with the same sheeting. The roof gutters are of pressed steel and are fitted with snow boards which can also be used as gangways. From the valley gutters the water is taken down the inside of the main stanchions to drains running longitudinally down the shops, while the water from the eaves gutters is taken down outside into similar drains. All the rain-water is drained to a neighbouring brook.

Foundry work forms a very special feature in the construction of mechanical stokers. Good clean castings of the best quality of iron are essential. The iron foundry at these works has been designed so that these requirements can be fully met. Like the machine shop, the structure is one in which glass predominates. In fact, it would be impossible to find a lighter foundry in any part of the country. One of the special features of the foundry is the cupola staging, which has been designed to accommodate two 15-ton and one 6-ton cupolas, and is large enough to keep stocks of pig iron, coke and limestone always at hand for charging purposes. To carry this great weight the steel work was constructed for a maximum load of 10 cwt. per square foot. The charging stage takes up exactly one bay inside the 45ft. span in the north of the building, and projects 10ft. 6in. on the outside of the wall. At one end of this outside extension is an electric lift for dealing with the materials for the cupolas. If necessary, the pig iron, &c., can be delivered direct on to the platform from trucks by means of steam jib cranes which travel on the rails outside. On the north side of the foundry, in line with the cupola stage, are bins containing the raw material, pig iron, coke, limestone, ganister, sand, &c. These bins are divided by a brick wall, and the sand bins are covered with a glass roof. Small sliding doors let into the brickwork of the wall communicate with the sand bins. The sand bins alongside the line adjoin the sand-mixing department in the foundry, being

FIG. 5—STORE YARD, SHOWING CUPOLA STAGE AND JIB CRANE

separated from them by a sliding door. This arrangement makes for easy handling in discharging the sand into the grinding mills and electric disintegrators. The railway lines run quite close to all the bins, so that the materials can be discharged at one handling. The foundry is equipped with all the most modern improvements. There are large drying stoves, hydraulically-operated moulding machines and sand-grinding and mixing machines. At one end is an annexe in which the rattlers and grinding machines are situated. They are all driven by electric power.

The two main buildings are of three spans each, one centre span of 60ft., and two side spans of 45ft. Each span is served by two electric overhead travelling cranes, by Herbert Morris, Limited, and the desirability of putting as few columns as necessary inside the buildings led to the adoption of a centre-to-centre spacing of 37ft. 6in. In order to facilitate the erection of mechanical stokers each of the main columns in the machine shop has an auxiliary swinging hand crane which operates through an arc of 270 deg., the intention being that these cranes shall be used so as to liberate the overhead electric cranes for all work which requires to be in the slings for some time. The motive power employed throughout the whole of the shops is electricity, but the handling of materials outside the shops is performed by long-jib steam-travelling shunting cranes. These cranes deal with the trucks after delivery into the sidings by the railway authorities, sort and shunt them, and then unload and transport the goods to their destinations. The jibs of the cranes are long enough to reach right on to the cupola platform, and thus, whilst large stocks are kept in their proper bins, incoming materials can be delivered directly into use, leaving the stock bins to be drawn upon as required. It will be observed from the plan that the railway siding runs straight through one end of the machine and erecting shop for the loading of finished machinery. The doors of the shop are sufficiently high to allow the shunting crane to pass through.

All the line shafting for the machine tools, &c., is motor driven, while in the foundry electric motors operate the compressors, the pumps for the hydraulic moulding machines, the sand, coal dust and other mills. All the electric power is obtained from the power station of the Derby Corporation. It comes into the transformer house at 6600 volts and is reduced to 400 volts three-phase alternating. The switchgear is contained in a building adjacent to the transformer house. This switchgear controls various main distribution boards in the shops. Each sub-circuit has its separate fuse. Spareways are provided on every board. The total power provided up to now is 325 kilowatts, to which more will be added as necessary.

For artificial illumination electricity is used throughout, but the lighting arrangement is varied to suit the different shops. In the foundry, for instance, large incandescent lamps are fixed to the underside of the centre cleaning gallery in the centre 60ft. span and to the principals in the 45ft. side spans. Gas-filled lamps of 1000 watts are used, and their positions and angle of reflection have been chosen so that no shadows are caused on the working floor of the foundry. The general effect is highly satisfactory. Additional smaller lamps are used for the cupola platform, compressor house, stores, moulding machines, and such like. In the machine and erecting shop a similar arrangement is made for the general lighting, except that the lamps are less powerful, while small additional lights are used for each machine tool. The lights are all grouped to main switchboards and are separately controlled by individual switches.

The pattern shop and stores form a separate building, the shop part being 70ft. long by 45ft. wide, and the same type of roof principal is used as in the larger buildings. A substantial brick wall divides the shop from the stores. Means of communication is provided by a doorway 8ft. by 6ft. The fire-proof door was made by Fireproof Doors, Limited. The building is provided with lantern swinging lights as well as roof lights. One side of the pattern shop has a concrete floor for the wood-working machinery, while the remainder is floored with creosoted wooden blocks. The store floor is of concrete throughout. The floor area of the pattern shop is 3375 square feet, and the glazed area in the roof and sides is 2996 square feet. The machine and erecting shop floor is of concrete and granolithic, while certain sections only of the foundry have a concrete floor, the remainder being of sand. The water and gas mains are brought underground and carried at a high level out of reach, with dropping pipe connections to all points. All the line shafting for the machine tools, &c., in the machine shop is motor driven direct through laminated gearing.

A special feature in the lay-out of the works is the space left between the machine shop and the foundry. This space is intended for a permanent storage for the castings—of which a large number is stocked—and distribution station. The space measures about 22,500 square feet and is subdivided by concrete cross roads leading direct from the fettling shop end of the foundry to the three large doors in the machine shop, or direct into the erecting shop or loading station as required. Electric trucks are used for transport purposes.

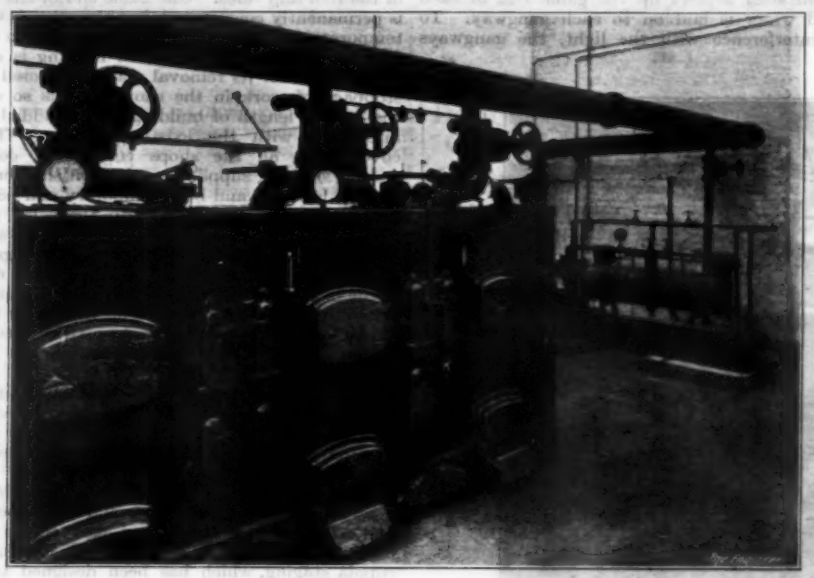


FIG. 6—HEATING-BOILER HOUSE

The Institute of Transport Congress.

AFTER meeting in Manchester in 1921 and in London last year, the Institute of Transport held its third congress in Sheffield last week. About two hundred and fifty delegates were present, and the Congress was opened by a reception by the President, Sir Sam Fay, at the Grand Hotel on Wednesday evening, the 13th. The formal proceedings took place on the following morning, when the Lord Mayor of Sheffield, Mr. Alderman W. C. Fenton, speaking in the Banqueting Hall of the Cutlers' Hall, extended a civic welcome to the delegates. In acknowledging it, the President said that, situated midway between the seas and midway between the rivers Mersey and Humber, Sheffield, above all industrial centres in this country, required adequate transport facilities, and the students and graduates of the Institute would be able to study on the spot the various transport organisations on which the city relied.

The Congress then divided into two bodies, one of which remained in the Banqueting Hall, under the chairmanship of the President, and the other adjourned to the Drawing-room, where Sir J. G. Broodbank, the President-elect, took the chair.

In the former room the first paper to be considered was:

"RAILWAY REQUIREMENTS OF AN IMPORTANT INDUSTRIAL AREA."

By J. A. JENKINSON, Associate Member.

The most important duty of a railway in an industrial area is to transport food to the population, and it is in the transport of goods and coal traffic that the real scientific study of railway operation is the most essential.

Based on the use of provisions by the ordinary householder, the weekly requirements of a population of 1,000,000 for food alone will amount to approximately the figures given in the table in the next column.

In this country the railway companies, as a rule, undertake the entire carriage of certain traffic from senders' to consignees' premises, involving five separate operations, a throughout charge being made for the services, viz.:—(1) Cartage from senders' premises to station; (2) transfer from railway dray to stage and into wagon; (3) haulage of wagon from station at point of origin to destination station; (4) transfer from wagon to stage and on to dray; (5) delivery to consignees' premises.

This throughout charge is a facility which is not provided in all countries, and is frequently overlooked by the uninitiated when comparisons are made of the rates in this country and in foreign countries.

It is not to the interest of the shareholder to charge such high rates that he kills traffic. It is more remunerative to convey 1000 tons of goods at, say, 35s. per ton, than 500 tons at, say, 40s. per ton. From the trader's point of view, although his carriage account at the end of a month may amount to a considerable sum, he must not overlook the fact that 40s. per ton is only approximately one-fifth of a penny per pound, whilst possibly his selling price may be 6d. to 1s. per pound. It is, to my mind, only in the heavier classes of traffic that the railway rates reach anything like a high percentage of the value, and in the case of such traffic the trader himself would not expect to be called upon to sell at a price less than cost.

Table of Weights.

	Tons.	Wagons.
Sugar	675	100
Butter	110	25
Margarine	110	25
Tea	110	25
Bacon, &c.	220	40
Meat	1,125	250
Potatoes	1,125	150
Flour	1,125	150
Soap	450	100
Household coal	11,000	1200
	14,050	2065

The logical cure of congestion and delays in the handling of traffic is the construction of a concentration yard into which to work traffic for a whole area, there sort it and convey to the actual destination point in train loads or in as large quantities as possible; and to draw the traffic from the sixty or seventy points of origin rough to the concentration yard and there sort and marshal for attachment to departing trains. It is, however, useless to provide a large theatre with insufficient entrances and exits, and so with a concentration yard, and in order to effect a complete cure for the congestion and delays, particularly if the through traffic as well as local traffic is heavy, it may be necessary to construct an avoiding line so that the major portion of the trains may avoid the most congested parts of the running lines; in many cases it might be economical actually to locate the concentration yard on the avoiding line with suitable connections with the different parts of the area and leave the old main line for passenger trains and trains not requiring to stop in the area. As a principle, it would, however, always appear that scientifically it is more economical to spend money in lay-out, and thereby reduce operating costs, than to spend it in locomotives and staff.

Unfortunately, owing to the fluctuations in traffic, the trains scheduled do not always meet the requirements of the traffic and, with limited exceptions, railways allow special trains to be worked to cover such traffic immediately a load presents itself, or immediately the locomotive department can provide an engine. This, perhaps, does much towards upsetting the working of trains generally, as the specials may be turned out from a yard at most inconvenient times for the line working, and here, I think, the French system might be emulated of providing what are termed "marches" for trains which may, or may not, run; in other words, numerous trains are booked to run when required. One or two British companies have, I think, adopted this principle, but there is not a general use of it. I hazard the opinion that much bad train working is the result of the indiscriminate turning out of specials at unsuitable times.

One cannot pass from the subject of goods train working without referring to "control." Much has been said and written of this, but when well defined it must be regarded as super-supervision. It cures many evils that exist on lines where it is not in operation; a good controller is invaluable but the human element enters here as in the signal-box, on the locomotive and in the shunting yard.

An industrial area requires much from a railway, much those responsible find it difficult to give. "Our aim to serve you" is what the railway official must always be studying, but there are many to serve. Like politicians, railways are always under the eye of the critics who regard their efforts in the light of result affecting themselves. Practically every train conveys traffic in the ownership of scores of different people; most trains convey long-distance and shorter distance traffic, every wagon of short distance traffic delays the long distance, and so frequently the centre line has to be taken to meet all requirements. It must be realised that a railway only exists because certain people risked their money years ago to build it and require to draw dividends. These shareholders even now carry burdens of taxation which prevent their enjoying the same financial return that can be obtained from many concerns they aim to serve.

If railways in this country had only been treated fairly at their inception it would be easier to-day to meet the requirements of industrial areas. However, the most must be made of the material available and every endeavour to ensure that scientific operation shall overcome the difficulties created at the inception of railways.

In opening the discussion, Mr. J. Smith, of the L.M. and S. Wicker Station, Sheffield, pleaded for better appliances to deal with consignments, and contrasted the provisions made by the railway companies with what was to be found in the manufacturers' works. If the railway companies improved their tackle, they could more quickly load and unload wagons, and so increase the tonnage handled. The President said there was no doubt the railways had outgrown their clothes so far as goods stations were concerned. He hoped the new railway organisations would look to the improvement of the equipment at stations.

The discussion having been closed, the delegates in the Banqueting Hall proceeded to the consideration of the paper:

"MODERN TRACKWORK AND ITS IMPORTANCE."

By Sir ROBERT HADFIELD, Bart., M. Inst. C.E., F.R.S.

Rails fail, in the main, either by fracture or by excessive

wear. There are, of course, other possible causes of failure, but by dealing with these two, most of the metallurgical troubles in connection with rails will have been solved.

In their main features all investigations lead to the following as the chief causes of premature failure of steel rails:—(*a*) Unsound or segregated steel; (*b*) improper physical condition of otherwise sound steel, that is, a wrong structure of the steel arising from faulty manipulation; (*c*) the progressive development of surface cracks on the tread of the rail. Of these, the first is of undoubtedly the greatest importance statistically.

The author proposes to indicate some of the more important metallurgical improvements, either accomplished or suggested, in the direction of improving rail steel. Although the author's own invention, in referring to alloy steels he naturally gives first place to manganese steel, because it was the first alloy steel to be applied successfully to trackwork, and its use has far and away exceeded that of any other alloy steel for this purpose.

About twenty years ago increase of traffic, higher speeds and additional weight of motive power and equipment, caused special attention to be focussed upon the outer rails of curves, and upon switches and crossings where the continuity of the rails is broken. The changes in the working conditions created a demand for crossings and other parts of the permanent way, for use in places where heavy traffic collected, which would be as reliable as the ordinary rails on the straight tracks. When these rails were used to form crossings the wear was exceedingly rapid, and even with crossings made as castings in ordinary steel renewals involving much expenditure of time and money were unduly frequent.

In 1902 solid cast "Era" manganese steel crossings for the British Museum Station of the Underground Electric Railways of London were installed, and in three years, after 218,000,000 tons of traffic, they showed comparatively little wear, although previous crossings at this site, built up from ordinary steel rails, did not last more than six weeks or two months. Several more years' service and 600,000,000 tons of traffic found these crossings still capable of further use. There are to-day hundreds of similar crossings on the Underground Electric Railway tracks of London, and it has been proved over and over again that there is nothing to equal manganese steel in meeting the onerous conditions on these lines.

About 1904 the main line railways in England began to show a greater interest than previously in the merits of manganese steel. The North-Eastern Railway used manganese steel crossings for their important Forth Junction, and, after about 170,000 tons of traffic per day for two years, the wear was scarcely appreciable. This was the predecessor of several installations on this railway, but it will be sufficient to mention the extensive and particularly important junction fixed in November, 1912, at the east end of the Central Station at Newcastle-upon-Tyne. This is a point conveying an extremely heavy traffic, both of steam and electric passenger, and also of goods and mineral trains. The heavy express traffic between London and Edinburgh is continually passing over these tracks. These manganese steel crossings and rails were all built up together at the works prior to despatch. There are no less than ninety-two crossings and rails, covering seventy-seven intersections, the total length of the junction is 141ft. 3in., and the width overall is 58ft. 6in., approximate weight 70 tons.

The question of rolled rails of manganese steel is an important one, and as early as 1904 the author's firm had rolled light Vignole rails, and experiments were continued in this direction until, in 1907, a large number of rails were rolled and supplied to the Metropolitan Electric Railway of Paris. These were Vignole section, 100 lb. per yard, and after about two years the total wear was only about 1 mm. to 1¼ mm. The ordinary steel rails wore out and required replacing in less than a year.

Amongst the first tramways in England to install manganese steel switches and crossings, mention must be made of Sheffield, Stockport, Salford, Darwen, Bolton, Birkenhead, &c. In those days the switches were only very short, *i.e.*, about 7ft. 6in. to 9ft. long, and, like the crossings, which were also very short in comparison with those of more modern construction, they were generally made straight. Nowadays the switches and crossings for junctions, &c., are longer and the extended legs are curved to the proper radius, so that instead of the rude shocks and shakings which the travelling public used to experience whenever the car passed over switches and crossings, there is scarcely anything of the kind, and the average passenger does not notice the change from the straight even when the car turns more or less quickly.

The points and crossings for the conduit system of electric tramways are much more difficult to manufacture and the work is complex in comparison with the requirement of tramways where the overhead trolley is used. The surface grooves and other parts of the rail have to be carefully planed, ground, &c., to the proper curves and shapes, and the conduit trackwork necessitates a number of heavy machine tools and many special appliances.

The steel castings themselves are of very complicated nature, and have to go together with a great degree of accuracy so as to insure the smooth running of tramcars. In the earlier contracts, the crossings were of a special grade of cast steel, and they were fitted with cast manganese steel pieces at the intersections; but for several years now the tendency has been to have as many of the crossings as possible of manganese steel throughout and of solid construction.

The extraordinary toughness of manganese steel, as a factor in its use for trackwork, is of course of importance. Efforts to increase resistance to wear by increasing hardness are sometimes countered by increased brittleness, but it is a most happy circumstance with manganese steel that its hard wearing qualities are accompanied by most extraordinary toughness, which can only operate to advantage in the direction of increased safety. The question of surface cracks on the wearing surface of rails is a case in point. A crack in the tread of an ordinary steel rail may be positively dangerous by leading to sudden rupture; if such crack should occur in manganese steel it would be transmitted with the greatest difficulty.

Special Steel for Rolling Stock.—While the present paper is devoted mainly to the question of steel for trackwork, mention may perhaps be made of the progress which is being made in the introduction of specially heat-treated steel and steel of special composition for working parts of locomotives and vehicles as well as of tramcars. At present their use has been more or less confined to crank shafts and axles, for which heat-treated steel has with several railway authorities become standardised, although its use is not yet general. Doubtless with the practical experience gained, and the confidence in its serviceability which the author feels is bound to result, its applicability for other uses will receive consideration.

While railway authorities are rightly conservative in their attitude towards suggested improvements, both in view of their financial responsibilities and also their responsibilities to the travelling public, the toll of human life, apart altogether from the material loss, demands earnest consideration of any means likely to mitigate this. Speaking as a metallurgist, however, the author does not think that railway engineers have profited sufficiently by the means ready to hand for improvements in this direction. He does not say so in any complaining sense, but rather in the spirit that the metallurgist has given his attention to these problems and, he believes, produced improvements which will go a long way to solve the difficulties of the railway engineer as regards not only track material but steel for many other purposes. He realises that progress in applying such improvements must necessarily be somewhat slow, but has hopes that we may at least see the application in the near future of the means available for dealing with that most important of all questions in connection with track work, whether rails, points or crossings, namely, the ensuring of sound steel, as well as the production and utilisation of special steels with higher ductility, and yet at the same time possessing greater durability.

In the discussion which followed, one delegate said that the results which had been obtained through manganese steel showed the importance of research on new alloys. Another suggested that in view of the high cost of equipment made wholly of manganese steel the author might consider the production of a track in which a superstructure of manganese for the wearing parts might be imposed on less costly material.

In the Drawing-room, the first paper considered was:

"AIR TRANSPORT."

By Major-General Sir W. SEFTON BRANCKER, K.C.B., A.F.C., Member.

I am not a transport expert, nor have I any real practical experience of the operation of the ordinary forms of transport. I stand before you, therefore, as an amateur equipped only with a considerable experience of aviation in all its branches, and I am here to ask the Institute of Transport to help this new and interesting enterprise, air transport, to establish itself firmly and soundly amongst the recognised means of communication and locomotion.

Unfortunately, air transport has earned itself a bad reputation in the business and financial world. In 1919, there were two sound courses open for the Government to pursue regarding air transport: (1) to run it as a State enterprise; (2) to attract really solid business organisations to operate it. It was decided, and probably rightly, that it coud not be run as a State enterprise; but, at the same time, nothing was done to induce solid capital to back the new development, and no assistance was given. The result was that, after a year, financial disaster befell the pioneers of the new industry. Since then the Government has helped air transport, but without a fixed policy or a guarantee of security of tenure to the operating firms. This really is the reason for the financial failure of air transport up to date.

On the other hand, its operating success has been considerable, and I trust that we are on the eve of a definite Government policy which will permit the operators to look ahead and make sound plans for the future. Fortunately, these past four years have been very interesting in providing data on which to base these future plans.

The cross-Channel services which have been running to Paris, Brussels and Amsterdam, are too short to give the real value in saving of time which is necessary for air transport to be a commercial success. Now that these services have been extended back to Manchester and on to Cologne and Berlin, a much greater saving of time can be accomplished and so greater and more reliable traffic should be obtained.

From these four years of work it has been possible to estimate roughly what air transport should cost. I will not burden you with figures, but I will simply state that, from the various calculations I have studied during the past year, I reckon the cost per ton-mile at 100 miles an hour with heavy traffic should be about 3s. 6d., and, with light and fluctuating traffic, about 5s., including everything, and working with existing equipment.

Experts in the older forms of transport may say that this rate of 100 miles an hour is unnecessarily high and would claim that, by lowering this speed—perhaps to 70 miles an hour—a great saving in costs could be accomplished. In my opinion, this is not so. Practical experience on the cross-Channel routes has forced me to the conclusion that the economic speed for air transport is 100 miles an hour in still air. Any lower speed will mean undue delay by adverse winds and consequent irregularity of running and will necessitate the carrying of very heavy loads of fuel. In addition, it has been calculated scientifically that theoretically the most economical rate of flying in still air is about 70 miles an hour; in all calculations regarding speed and fuel endurance, in making up time-tables and estimating paying loads, a possible headwind of 30 miles an hour must be considered; these figures again lead one to the conclusion that 100 miles an hour in still air is the best economic speed for aircraft on a regular service which must run to time. But, of course, this is not a hard and fast rule for every form of air transport, and I will deal with the matter further, later.

Now as regards fares and rates, a ton of useful load covers roughly ten passengers with luggage. Transport experts tell me that in such calculations one cannot count on more than half a load on the average, and, assuming this as a basis for calculation, it will be seen that, with light and fluctuating traffic, five passengers can be carried for 5s. a mile; that is, 1s. a mile each. With heavy traffic, this cost is reduced to about 8½d. a mile each. I believe that ordinary passengers cannot be expected to pay more than 6d. a mile for rapid journeys. If this is so, it is obvious that air transport has not yet reached a point at which it will pay its way.

To sum up, my claims are that air transport has attained: (1) a high standard of reliability in running, the greatest enemy to absolute reliability being bad visibility; (2) a very high standard of safety; (3) a cost of operating which, although high, is not unreasonable.

Wireless is going to help enormously to overcome the trouble of bad visibility. Already, dependable telephone communication is being maintained between pilots in the air and stations on the ground. To-day, on the cross-Channel services, pilots are told exactly what the weather is at any given point on the route and the state of affairs at the aerodrome to which they are flying and at others in the neighbourhood. On his request by telephone a pilot can be given his exact position on the map by means of direction finding stations, which are continuously in action. The perfection of this wireless system will, in my opinion, entirely eliminate the danger of the pilot losing himself and, if his terminal aerodrome is impossible through fog, will enable him to find somewhere else to land.

The second weak point—that of cost—will, in my opinion, also correct itself. Really heavy traffic will bring down running costs considerably. Now aircraft are being developed which are going to carry a greater paying load per horse-power, and which at the same time will be less costly to maintain; this will appreciably reduce the cost per ton-mile. The use of heavy oil in the future is almost certain, and, when it comes, the costs of fuel and of engine maintenance will undergo an enormous reduction.

There are other factors of importance which are being studied and which are beginning to give results. The amount of work that should be done by each aircraft and engine during the year; the number of hours' flying which a pilot can accomplish without injury to his health and nerves; the proper administration of the *personnel* in the interests of economy; the comfort of passengers in the air, and the proper handling of passengers and goods on the ground. These are all problems which have been solved by other forms of transport before, and the principles governing them in the air are very much the same as those on the ground. With four years' experience, I think I can say that each aeroplane should be able to do at least 2000 hours' flying in the year; that three engines are necessary for each aeroplane in service to keep it in constant work; and that a pilot can be counted on to fly for about 600 hours in the year without injury to his health.

There is a school of thought that maintains that the large aeroplane must soon replace the small one, and that heavier-than-aircraft, carrying as many as 100 passengers, will be the solution of the problem of making heavier-than-air transport a paying proposition. Large heavier-than-aircraft will undoubtedly come, but, personally, I believe that it is desirable first to push on with the development of efficient small aeroplanes and to employ them on any new services organised in the immediate future.

Mr. E. S. Shrapnell-Smith said in the discussion that he would not be opposed to a subsidy for air transport, although the motor transport business never had such such help, and ninety-nine men out of every 100 who went into that industry twenty-five years ago lost everything they put into it. Mr. H. Mattinson—Manchester Corporation Tramways—had no misgivings as to the ultimate financial success of air transport, but he felt that it would have to fight against abnormal difficulties. Mr. C. J. Selway—passenger manager, southern area of London and North-Eastern Railway—thought there was no need for air transport within the area of Great Britain, and seeing that older forms of transport had succeeded without State aid, he did not see why it should be subsidised. Mr. E. C. Cox—chief operating superintendent, Southern Railway—said that it was one thing for the State to subsidise a commercial enterprise which was new to the country and which had no competitors and quite another thing to assist one form of transport against all other branches of the industry. Mr. Handley Page desired State aid for civil air transport, so that pilots and mechanics could be trained and machines and buildings be planned.

In the afternoon of Thursday visits were paid to the works of Messrs. Vickers, Hadfield, Steel, Peech and Tozer, and the Parkgate Iron and Steel Company, and to Sheffield University. In the evening the Lord Mayor and Lady Mayoress entertained the Congress at a conversazione at the Town Hall.

On Friday, in the Banqueting Hall, consideration was given to the paper:—

"BRITISH AND AMERICAN ROAD CONSTRUCTION AND MAINTENANCE."

By A. DAYLAND, Member of Council.

Just as America generally may be said to have been developed by the railways, which were largely built in advance of population, so the internal traffic in the cities was provided for by the rail tractor, every community of any size having its "street cars," and adjacent cities were connected in the same way.

There are considerable differences to be observed in the kind of traffic and the weight of traffic units. During a tour of Canada and the Eastern States nearly two years ago, I was particularly impressed by the number of light cars, and, on the contrary, the small proportion of the heavier traffic units with which we are familiar. The cheapness of cars and inexpensive operation, coupled with the high wages, has enabled anybody with a few dollars to own a car, to the extent that most artisans and even labourers are able to run their own vehicles. The completeness of the street car service in the towns and the individual ownership of small cars for longer journeys has doubtless prevented the development of communal machines such as our motor omnibuses.

When we turn to structural and maintenance methods it is again necessary to treat separately the cities and the country, there being more variation from our methods and standard in the latter than in the former.

With regard to the cities, there is considerable similarity with our own methods. Most of the street car routes are paved with setts, the track being often laid on cross sleepers set in concrete. This is a method which I have not come across in this country and I do not think it is as good as ours, although I am bound to say it appeared to be

more satisfactory than I should have deemed possible. There was, undoubtedly, some occasional displacement of the sett paving arising from movement in, or expansion of, the sleepers due to the access of moisture.

Wood-paved streets are comparatively few, and what I saw did not produce such good results as we attain. I think one reason is the use of hard pine which, like the hard wood so common in this country a few years ago, has the appearance of separate bricks or blocks instead of the "burred" oven surface obtained with our creosoted deal. I gathered also they had difficulty in keeping the blocks down. The extremes of temperature and great variation of humidity are, no doubt, the principal causes of this difficulty.

The favourite street pavement in America is undoubtedly what they term "sheet asphalt," which corresponds generally to what is known in this country as "asphalt macadam." I formed the decided opinion that this sheet asphalt work was particularly good, and it appeared to be much more free from corrugation than similar work in this country. How much of this superiority is due to the perfection of their methods, and to the somewhat greater "hardness" of their matrix, I am unable to say, because I realise that the much lesser weight of their traffic units imposes a greatly decreased stress upon the wearing surface.

The real "hard" road programme, which has had to be preached up and popularised in order to convert the community to expenditure on public roads—to which they had hitherto been entirely unaccustomed—is mainly concentrated on three methods, viz. :—The all-concrete road, the brick road, and the bituminous road. Each kind has its apostles, stimulated in each case by strong and highly organised trade interests, using all the powers of the Press and every known method of publicity to forward the interests of its particular system. I had the advantage of being put into close communication with the head organisations on all sides, and derived a great deal of information and no little amusement from the rivalry.

It was realised at the start that, with a huge mileage, it was not possible, in the first instance, to provide a hard surface for any great width, and all the early work was of only 9ft. width, either of concrete, brick or asphalt; but to allow of passing, the shoulders for some 3ft. to 6ft. on either side were made up with gravel or macadam. The American car driver has not been brought up on smooth travel, and the light American car swishes off one wheel on to the rough side, often with a drop of 3in. or 4in., and back again and thinks he has nothing to complain of. What would our English motorists say? However, even the American motorist, having tasted the joys of a smooth and firm road, was not satisfied long with the 9ft. width, and many lengths are being widened to 16ft., 18ft., or 20ft., and most States are endeavouring to set up a standard of 20ft. for their new construction on important arteries.

The all-concrete road has had an increasing vogue, growing substantially in quantity each year since the war, and is giving good service under the traffic conditions which exist. Whether it will withstand a large increase in the heavier units of traffic has yet to be seen, but American road engineers are alive to the problem they have to face and the State Legislatures readily, on their instigation, pass laws governing the use of roads by vehicles, and define strictly the allowable conditions as to axle weights and speeds.

The bituminous road—in various forms—is extending to a great or possibly greater extent than the all-concrete road. The difficulty is to find a foundation on which to lay it. A strong endeavour is made by the "all-bitumen" advocates to fight for a bituminous concrete base with a wearing surface added of finer materials; but I think the tendency, even where bitumen is strongly in the ascendant, is to lay a base 6in. thick of Portland cement concrete with a 2in. or 3in. bituminous carpet thereon.

It is only in quite recent years that Americans have realised the necessity for a maintenance organisation. They started out with the idea that, having constructed a length of road, it could be left to take care of itself, not realising that a structure—subjected not only to the elemental forces of nature, but to varying and severe stresses by usage—would certainly develop small defects which require speedy attention to prevent extensive deterioration.

The Americans are far in advance of ourselves in the utilisation of mechanical appliances, and this applies to every operation in connection with road construction, to such an extent that the American workman does little "hard graft," but is more of a tool operator. Undoubtedly mechanical appliances can materially expedite and cheapen the execution of works on any considerable scale, and had it not been for the exceptional circumstances in regard to unemployment from which we have so long been suffering, I have no doubt, greater use would have been made in this country of similar appliances. I think it is mainly in that direction that we can take lessons from overseas.

In concluding the discussion on Mr. Dryland's paper the President, who was in the chair, said that he thought a very large increase in road traffic might be looked for. It would be to the general advantage of the country, for he did not look upon the question as one of roads *versus* railways. Without doubt it was cheaper to take traffic, even considerable distances, from door to door than to take it to a railway station, unload and load and then unload and load at the other end. His own experience was that there was a good deal of traffic taken to-day by the railway companies which did not pay them a cent, and it would be to the advantage of the railway companies if they never saw it. Somebody had to suffer for that.

The next paper taken was :—

"TRAMWAYS FROM A TRAFFIC POINT OF VIEW UNDER EXISTING CONDITIONS."

By E. S. RAYNER, Member.

It is the unqualified comparison of tramways with motor traffic that accounts for the thoughtless, but somewhat popular, assertion that tramways are obsolete; the same individual will allege that railways are obsolete because air services have been established.

It is not possible to redesign and rebuild our cities, and the only alternative is to make the best use of existing thoroughfares, to remodel entirely our ideas, to cease thinking of thoroughfares as having an unlimited capacity for traffic of varying capacities and speeds, and regard them as tracks with a limited capacity, and to regulate the vehicles upon them both as to type and speed—high as well as low—if the full capacity of our streets is to be developed.

I have taken some rather interesting tests of comparative speeds of omnibuses and tramcars under varying conditions and densities of traffic. The data was obtained by timing, with a stop-watch, trams at short intervals along the whole of the journey, and also taking the time of loading and unloading passengers and doing the same with omnibuses along the same routes under as nearly similar conditions as it was possible to obtain; it was found that up to 1¾–2¼ miles from the centre of the city through the denser traffic and narrow streets with a maximum number of stops, there is nothing in it between the two, but after that, in the broader roads with diminished traffic, the advantage lay with the omnibus. This is due to the fact that the omnibus could and did develop very high speeds, much higher than the tramcar.

The speed of the vehicle is not the only consideration; the real criterion is the speed at which the maximum number of passengers can be moved in the minimum length of time, the cost of doing it and the economical use of our streets.

In the first case, tramways have the advantage of greater capacity. Comparing the latest type of tramcar with the latest type of omnibus in use, the capacity of the tramcar for all weathers is approximately double that of the omnibus, and the bigger platforms and wider entrances give it a greater advantage in the loading and unloading of passengers.

In the second case, the cost of the tramcar is always a decreasing figure as the numbers to be moved increase, whereas, with the omnibus the cost is practically constant. The last consideration is comparatively new but one of increasing importance.

The fact that trams are restricted to a fixed track, although it may at first sight appear a disadvantage, is in reality a blessing in disguise—it ensures that each tramcar shall take its proper station.

The question of capacity relatively to speed is receiving the closest attention of tramway managers; the size of the tramcar is rapidly approaching its economic limit, but there is a considerable margin left before the capacity of the track is exhausted.

The average time taken to load a 60-seater car from a queue, with sitting and standing passengers, is 1 min. 16 sec., which means that, on a section that is running with a half-minute headway, at least two additional cars would be held up during this operation, and when this occurs in the centre of the city there is obstruction.

In the discussion which followed, Mr. A. R. Fearnley, manager of the Sheffield tramways, said that the industry was suffering from some injustices. A municipality was capable of gove ning half a million people and yet could not imp ove the speed of the cars without the sanction of a Government department. Mr. E. S. Shrapnell-Smith thought that in the near future there would be sanction for six-wheeled omnibuses; he had seen designs for six-wheeled omnibuses, with double decks, to carry 120 people each.

In the Lower Hall, where the meeting was presided over by Sir J. G. Broodbank, the following paper was taken :—

"CARGO HANDLING AT PORTS: BRITISH AND AMERICAN METHODS COMPARED."

By BRYSSON CUNNINGHAM, D.Sc., B.E., M. Inst. C.E.

To any British port official visiting the ports on the Atlantic Coast of the North American Continent, or, in fact, any North American port, the variation from British practice in the lay-out of the port accommodation, the design, construction and equipment of the quays and sheds, cannot fail to be striking. While, perhaps, it may be considered unnecessary to dwell as a class on those differences which arise purely from a conformation to physical conditions, it will certainly be desirable to touch on one particular factor which exercises an extremely far-reaching influence, and controls, in fact, the disposition and working of ports in a way which is fundamental. This is the phenomenon of the tides. In this country, the waters of our principal ports—as, for example, London, Liverpool, Bristol, Cardiff and Hull—are characterised by very pronounced variations of level at different hours of the day, due to the flow and ebb of the tides. These variations are of the order of 20ft. to 40ft., and the ports in question are confronted with the necessity of providing and maintaining artificially impounded areas of water, within which shipping can be accommodated, not only continuously afloat at periods of low tide, but also at a fairly uniform level, in order that there may be as little interference as possible with moorings, and a convenient continuity in loading and discharging operations. In other words, dock systems are more or less a necessity on the seaboard of the British Isles. Not invariably, for some ports—such as Glasgow and Southampton—are favoured with a tidal range, which is not so extreme as to demand locks.

Now, on the other side of the Atlantic, although there are certainly a few exceptions where tides of notable range are experienced, yet the general rule is the other way. There are no enclosed docks, and no occasion for enclosed docks at New York, Baltimore, Philadelphia, Boston, Montreal and Toronto.

While shipowners and ships' masters may very naturally prefer to employ the ship's equipment for cargo handling, there are certain impediments which stand in the way of the full or sole use of these appliances. The principal disturbing element is the tidal range. Where this is at all considerable, the difference in level of the ship's deck and the quay may at times render the use of the ship's gear impracticable. Obviously, this disability can only affect riverside quays and wharves, where the tide has free play, and it cannot apply to docks where the water level is maintained at a fairly uniform level. But, in docks, other considerations enter into account, and commend the use of quay cranes, the principal being the very much greater range of useful work of cranes and the freedom to dispense with the ship's working machinery, boilers and so forth, which can be laid off for overhaul and repair. On this side of the Atlantic, cranes are practically everywhere in evidence, sometimes working alone, but not uncommonly in conjunction with the ship's whips and winches, to which they prove a valuable adjunct.

So, arising either altogether or in part out of the respective tidal conditions, open piers without cranes are the general rule on the western side of the North Atlantic and enclosed docks with cranes on the eastern side.

In America, the difficulty is got over by the installation on the quay of certain structural features termed cargo hoists and masts. Along the shed front, considerably above the eaves, and perhaps some 70ft. or 80ft. or so from quay level, there is a longitudinal girder or rail, supported at intervals of a shed's bay width by vertical standards, which are, in fact, prolongations of the shed columns or stanchions. This rail or girder affords an unlimited number of points for the attachment of pulley blocks, and these, when in use, are so arranged as to be opposite the hatches where work is carried on. Each pulley block on the shed rail is operated in conjunction with another block on the ship, at the upper extremity of a boom set over the hatchway.

It is frankly admitted in the recent report of the New York–New Jersey Harbour Commission on the Port of New York that ships' gear combined with cargo hoists do not suffice to produce the best results, and the introduction of quay cranes to supplement them is strongly recommended.

There is another side issue to the matter which should not escape mention. Whereas British wagons are mainly of the open or uncovered type—except for the conveyance of perishable produce—American cars are almost invariably closed-in or boxed cars, the principal, if not the only, exception being coaling wagons. Goods cannot be handled in and out of a closed box car as conveniently as they can be deposited or removed from an open wagon. This is a consideration which has militated against the use of quay cranes at American ports, but it is not regarded as an insuperable difficulty. There is plenty of scope for the services of quay cranes apart from rail traffic.

The value, or at any rate the indispensability, of the quay crane, therefore, may be regarded as admitted, and at English ports the crane has been brought to a very high pitch of development.

At many ports a considerable quantity goes overside into barges or lighters direct. This, for instance, is the case at New York, where floating derricks are in general use for loading and discharging cargoes in bulk. These have a greater lifting capacity and a wider range than a ship's boom, but their principal function is that of transferring cargo to and from piers for overside delivery operations.

Another prominent feature of New York harbour traffic is the car transfer float. Of the twelve main trunk lines of railway reaching New York, nine have their termini on the west bank of the Hudson and the goods for Manhattan are conveyed across the river in car floats. For the outward journey the cars on these floats are loaded by truck. The floats are of two kinds. One has a central loading platform with a line of cars, or wagons, on each side. Others have three parallel tracks without a loading platform. Tugs supply the propelling power.

As regards handling the cargo in and through the sheds, the principal appliance in vogue at American Atlantic ports is the mechanically propelled tractor, with a train of trailers, numbering up to perhaps a dozen. At British ports, mechanically propelled vehicles are common, but, speaking generally, the single unit, self-contained conveying truck is favoured in preference to the tractor and railer system.

A large proportion, the major part, in fact, of American exports consists of cargoes in bulk—grain, oil, ore, &c.—and the appliances for handling these are of considerable calibre and have attained a high degree of efficiency. To indicate the difference in scale on which such goods are handled, it is only necessary to point to the railway coal wagon. In this country, we are quite content to jog along in the majority of cases with the old-fashioned type of wagon holding 10, 15 or 20 tons net, whereas in America the capacity is from 40 to 100 tons or more.

The typical means of coal handling at ports in Great Britain are the coal hoist and the coaling crane. In the former case, the wagon is lifted on a platform to the required height, in order to clear a steamer's sides, and then tilted so that the coal is discharged into a shoot which directs it into the hatchway. In the second case, the wagon is lifted bodily by a crane, slung over the hatchway and there emptied. In America, the belt-conveying system, of which there are, of course, several examples at British ports, is being rapidly developed in competition with the direct tip.

As regards bunker supplies, a typical American apparatus is the Minchener or De Mayo portable bucket elevator, which fills the bunkers of liners at the rate of 125 tons per hour. It is a bucket elevator of the ordinary type suspended in position from a boom, either fixed on the wharf or attached to the vessel to be loaded. It is somewhat surprising, however, to find that at a port like New York not more than 10 per cent. of the bunker coal is loaded on board ship by special coal-handling machinery. The usual practice is for the shipowners to employ stevedores to load the coal by hand into buckets and use the ship's tackle to hoist the buckets over the side of the ship. This is a very primitive arrangement for an enterprising port.

The latest type of coaling appliance at the Port of London is known as the Suisted elevator. It is a floating structure having a framing mounted on two parallel pontoons, each 75ft. long, 11ft. 6in. wide and 18ft. deep, with a space between them sufficient to allow a barge to come under the elevator.

On Friday afternoon visits were paid to the works of Cammell Laird and Co., Staveley Coal and Iron Co., John Brown and Co., Thos. Firth and Sons, Cravens Railway Carriage and Wagon Co., and the London and North-Eastern Railway (Doncaster). In the evening the Master and Mistress Cutler (Mr. and Mrs. R. W. Matthews) entertained the Congress at a conversazione at the Cutlers' Hall. On Saturday morning visits were paid to Immingham and Goole.

THE Aberdeen-Penzance through service is to have its own sleeping cars during the summer months, and southbound passengers will then no longer have to wait until they arrive at York and north-bound at Swindon to get to their berths.

A Seven-Day Journal.

The Rolling of Ships.

RENEWED attention is being paid to the problem of preventing the rolling of a ship in rough water. To the naval engineer a steady platform for gun-firing is necessary if accurate marksmanship is to be maintained, while for the general passenger the advent of a liner with a successful anti-rolling device would remove many of the discomforts of sea travel. In connection with the first named use of a stabilising device, it is of interest to note that a new form of gyroscopic stabiliser has just been constructed at the Trafford Park works of the Metropolitan Vickers Electrical Company, Limited, to the patented designs of the Sperry Gyroscope Company, London. This device, which is said to be the first of its kind to be manufactured in Great Britain, will, it is understood, be fitted to a naval vessel for the completion of certain tests which are being made by the Admiralty. A similar design of stabiliser has been used in America with, it is claimed, very satisfactory results. In the new Hamburg-American liners, the Albert Ballin and the Deutschland, the problem has been attacked in a different way by utilising some of the centre compartments of the two bulges as Frahm anti-rolling tanks. Under the later patents of Dr. Frahm there are no connections between the tanks internal to the ship's skin. The results obtained from both these systems will be awaited with interest.

Motor Manufacturers and Marine Exhibitions.

FROM a statement of policy regarding participation in marine exhibitions, issued by the Marine Committee of the Society of Motor Manufacturers and Traders jointly with the Ship and Boat Builders' Association, we gather that these two bodies have reached an agreement as to the course they intend to pursue in common in the future. Following the example, we presume, of the machine-tool makers, they have laid it down that in the interests of the trade and the public the number of exhibitions held should be limited, that when they are held they should be as comprehensive as possible, and that their organisation should be in the hands of representative trade bodies not actuated in the promotion of the exhibition by any desire for financial gain. It is expected that, by arrangements recently made by the Society of Motor Manufacturers and Traders regarding the use of Olympia, it will be possible to organise future marine exhibitions in October or November in alternate years. At the forthcoming Shipping, Engineering and Machinery Exhibition at Olympia in September, the Society and Association will, we understand, be represented in a separate section organised under trade auspices. The members of the two bodies are now being asked for an expression of their views regarding the organisation of a marine exhibition next year in either October or November, when it is expected many overseas visitors will be in London in connection with the British Empire Exhibition.

The World's Largest Submarine.

ON Saturday of last week the new British submarine X 1, stated to be the largest and most powerful vessel of her type in existence to-day, was launched at Chatham Dockyard, under conditions of much secrecy. As we recorded in our issue of May 25th, this new submarine has a surface displacement of 2780 tons and a submerged displacement of 3600 tons, as compared with the 2158 metric tons surface displacement of the largest submarine previously built, the German submarine-cruiser 142. It has been stated that as the X 1 was laid down before the Washington agreement was signed, we have a free hand as regards her armament, and that she will probably be provided with a 13.5in. gun. It has also been reported that she has been designed to operate, if need be, at a greater depth—namely, 500ft.—than any previously built submarine, and that to permit her to do so she has been constructed with scantlings and plating of unusual dimensions. Information regarding her speed indicates that both awash and submerged she will surpass any vessel of her type, and that at cruising speed she will have a radius of action of 6000 miles. Following upon the success attained in other naval vessels, she is to be equipped, it is reported, not only with Michell thrust blocks but with Michell journal bearings for the propelling machinery and shafts. Her total estimated cost is £820,000.

A New Stainless Alloy.

FOR some time past reports have been received of efforts being made to discover a new stainless non-ferrous alloy. It appears that towards the realisation of this object important developments have now taken place, and that Mr. Etchells and Mr. Popplewell, of L. C. Cameron and Son, Limited, steel manufacturers, Sheffield, have completed experiments which have led to a new stainless alloy being placed on the market. The material is claimed to be superior with respect to its corrosion resisting properties to any existing stainless iron or steel and to possess good mechanical properties. It is stated to be easily worked and to be capable of being produced in the form of wire or the thinnest of sheets. Its properties, so it is said, are not affected by hot working, it can be readily forged either hot or cold, it takes a high polish, and has a permanent colour equal to that of nickel silver. It is now being manufactured, we understand, by Messrs. Cameron for general purposes, and by William Gillimore and Son, Limited, Sheffield, in the form of blanks for the manufacture of spoons and forks.

The New Ironmongers' Hall.

THE foundation stone of the new hall of the Worshipful Company of Ironmongers in Shaftesbury-place, Aldersgate, was laid last Friday by Major Cecil Stedall, Master of the Company. The hall previously occupied by the Ironmongers was situated in Fenchurch-street. It was built in 1457, and was rebuilt on two occasions, namely, in 1587 and in 1780. The hall as rebuilt for the second time was almost destroyed on July 7th, 1917, by a bomb which fell in the courtyard during a daylight raid by German aircraft. In the new hall the basement will contain a strong room for the Company's archives and plate. On the ground floor there will be an entrance vestibule, offices for the clerk, the Court Chamber, and a luncheon room. On the first floor will be a reception room and banqueting hall, while above will come the kitchen, Beadle's quarters, and members' changing rooms. The new hall has been designed by the Company's surveyor, Mr. Sydney Tatchell, and is being built by Holland and Hannen and Cubitts, Limited.

The Largest Aeroplane.

A REPORT from Dayton, Ohio, states that Mr. W. H. Barling is now assembling at McCook Field, the Army Air Station, a military aeroplane which is claimed to be the largest the world has known. This machine, a triplane for bombing purposes, is to be driven by six "Liberty" engines, and will exceed 40,000 lb. in weight, exclusive of the crew of four to eight men. Its dimensions are given as:—Wing spread, 120ft.; height, 28ft.; overall length, 65ft. The claim made for it, like several other claims advanced recently in connection with American aeronautical developments, is not justified. It is definitely not the largest aeroplane the world has known, for in all the respects for which we have data it was exceeded by the Tarrant machine, completed at Farnborough in 1919. That machine was equipped with engines developing 3000 horse-power, had a weight 45,000 lb., a wing spread of 131ft., a height of 37ft., and an overall length of 73ft. It resembled the new American machine in being a triplane and in having six independent engines. We may hope that the American machine will not resemble the Tarrant in the disastrous ill-fate which overtook it on its first attempted flight, a disaster attributed to the pilot's endeavour to hasten his departure from the ground by switching on the two upper engines before the machine was completely air-borne.

Glasgow's Tramways.

AN unauthenticated statement recently circulated to the effect that for the first time in its history the Glasgow Corporation's tramway system would, for the past financial year, show a deficiency is far from confirmed by some official figures issued on Monday. While the total revenue has decreased by about £100,000 as compared with that received in the previous year, the expenditure has fallen by more than £200,000, with the result that the net revenue shows not a deficit but actually an increase of over £100,000. It is true that the common good fund is to benefit only to the extent of £20,000 this year, as compared with £153,000 last year, but, on the other hand, nearly a quarter million sterling more has been set against renewals and depreciation this year than was apportioned last year. Far from showing a deficit, it is obvious that the Glasgow tramway system is in a very healthy state, more especially when the industrial depression and the new responsibilities assumed during the past year—such as the taking over of the subway railway—are taken into consideration.

The Boilermakers' Dispute.

FOLLOWING a suggestion made last week by the Minister of Labour, the representatives of the Boilermakers' Society approached the Shipbuilding Employers' Federation, with a request for another conference to discuss the lock-out of the Society's members from the federated yards. The employers acceded to that request, and the conference is being held in London to-day—Friday. The lock-out has now lasted eight weeks, and has involved idleness to nearly ten thousand boilermakers, and a loss in wages to them totalling some £320,000. In addition, other workers dependent upon the boilermakers, to the number, it is said, of about 13,500 men, have been rendered idle by the lock-out. The wages of these men, together with the State relief which they have been receiving, represent, it is estimated, a further loss of £750,000, so that all told the lock-out has resulted in a loss of well over a million sterling to the men, apart from the very considerable loss sustained by the employers. How great the loss to the latter has been may be judged from the fact that since the trouble arose one firm of shipowners alone has placed on the Continent repair work representing a total value of £50,000 which otherwise would have been executed on the North-East Coast.

The Cunard Liner "Franconia."

TO-MORROW—Saturday—the new Cunard twin-screw geared-turbine steamer Franconia leaves Liverpool on her maiden voyage to New York *vid* Queenstown. The vessel revives memories of the earlier liner bearing the same name, which, after a brief and successful Atlantic and Mediterranean service, was sunk by a torpedo near Malta in October, 1916. Constructed to the designs of the Cunard Steamship Company, Limited, by John Brown and Co., Limited, of Clydebank, the new Franconia is 623ft. 6in. in length, 73ft. 6in. in breadth, 45ft. in depth, and has a gross tonnage of about 20,000 tons. Her machinery is of the twin-screw double-reduction geared-turbine type, designed for a total shaft horse-power of 12,500, corresponding to a service speed of over 16 knots. A notable feature of the design is that the ship has been constructed for long ocean cruises, as well as for the Atlantic service. This purpose is reflected in her comfortable and well arranged accommodation and the ample provision made for sports and exercise. The excellent qualities of this new type of double-purpose ship were demonstrated in her speed and manœuvring trials, which took place off the West Coast of Scotland earlier in the month, and in a short cruise which was made from Liverpool about two weeks ago. The Franconia will continue her Atlantic route service until the autumn, when she is scheduled to start on her first long cruise.

Sixty Years Ago.

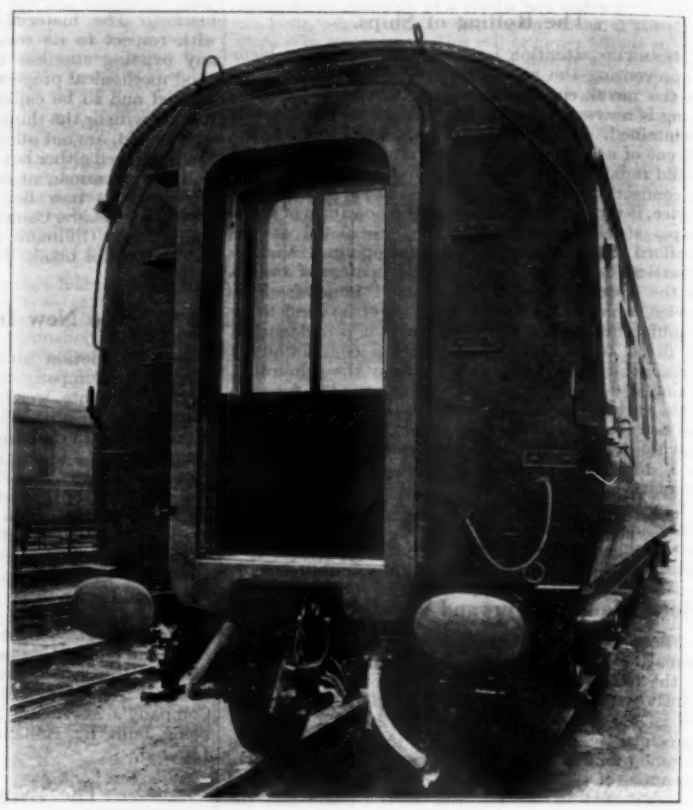
OUR issue of June 19th, 1863, contained the obituary notice of Captain William S. Moorsom, a prominent figure in the history of railway development in this country. It was he who, in 1836, was entrusted with the survey for a railway between Birmingham and Gloucester, and who boldly proposed to carry the line from the valley of the Severn to the tablelands of Staffordshire by the construction of the severest incline then known in the world, the celebrated Lickey incline, rising more than 300ft. in a little over 2 miles, or at the rate of 1 in 37. The scheme was opposed by George Stephenson, who strongly favoured avoiding the incline by a detour of 7 miles. Brunel also opposed Captain Moorsom's scheme, but in the end the opposition was negatived in Parliament, and Captain Moorsom's original plan carried out. Even after the line was constructed Captain Moorsom met with opposition, for whereas he proposed to work the incline with ordinary locomotives, his directors became alarmed, and advertised for tenders for the erection of stationary engines. Fortunately, it is recorded, the amounts of the tenders received were so high that Captain Moorsom was allowed to proceed with his plans. He found, however, that all the leading locomotive builders, including Robert Stephenson and Co. and Mr. Burry, of Liverpool, declined the task of providing the engines required to work the incline. In his dilemma he turned to America, and from Mr. Norris, of Philadelphia, secured a small locomotive weighing less than 10 tons, with 4ft. driving wheels and cylinders 10½in. in diameter and 18in. stroke. With this engine he demonstrated the practicability of working the Lickey incline in accordance with his original proposals. Another interesting chapter in this gentleman's life opened with his appointment by the Colonial Minister to determine whether a railway could be profitably constructed in Ceylon between Colombo and Kandy. Within five months of receiving his instructions, he reported favourably, and estimated the cost at £1,006,000. A company entrusted with the work, after two years' investigation, reported that it could not do it for less than £2,214,000. Mr. Hawkshaw, called in by the Colonial Minister, estimated the cost at £1,872,000. Captain Moorsom, however, persisted in his first view, and Mr. Hawkshaw's advice being repudiated, the Ceylon Government advertised for tenders, with the result that a contract was arranged with Messrs. Faviell at £1,019,000, or within £13,000 of Captain Moorsom's original figure.

NEW G.W.R. COACHES FITTED WITH AUTOMATIC AND SCREW COUPLINGS

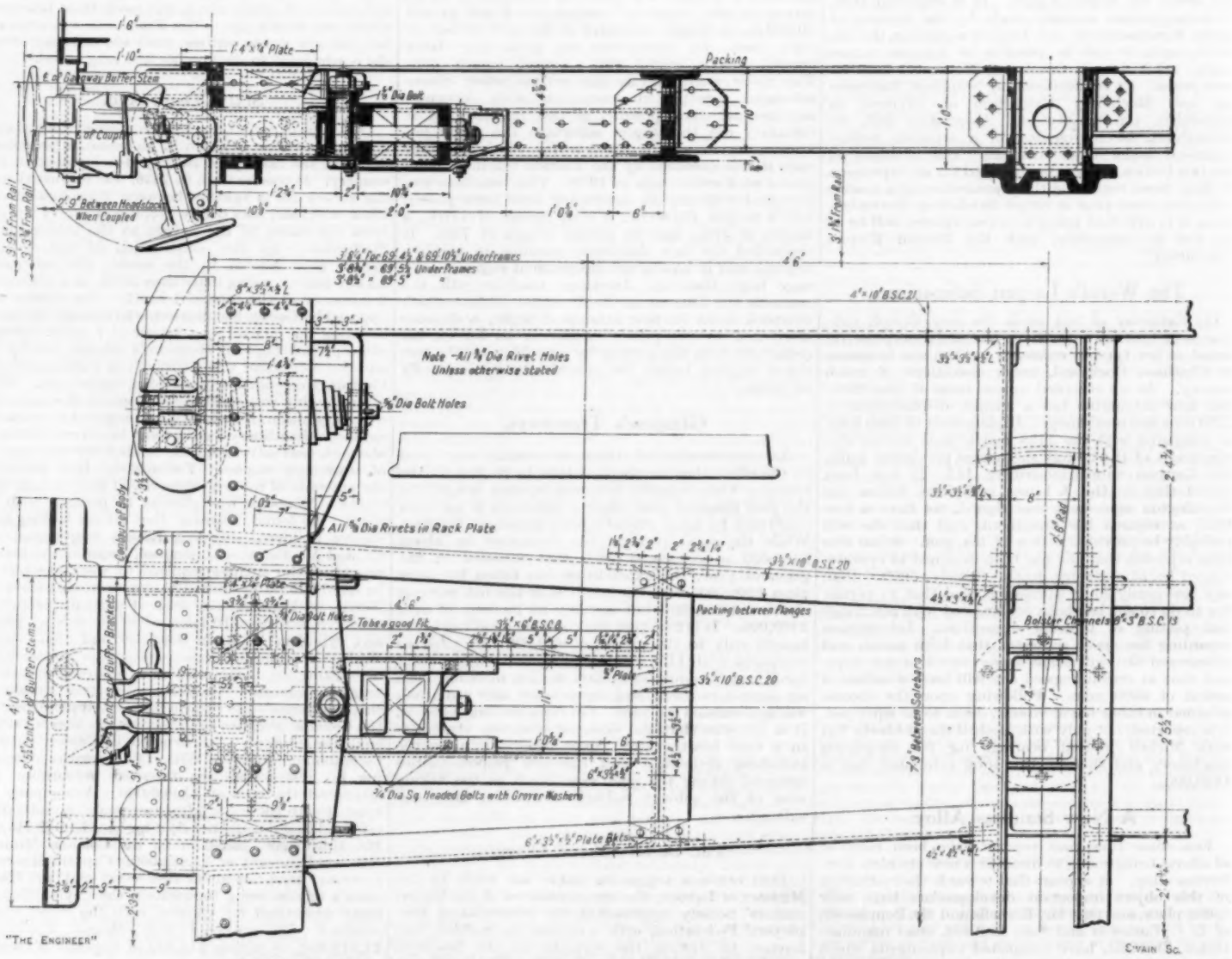
MR. C. B. COLLETT, SWINDON, ENGINEER

(*For description see opposite page*)

COACH WITH COUPLER IN POSITION AND BUFFERS LOWERED



COACH WITH COUPLER LOWERED AND BUFFERS IN POSITION



SECTION AND PART PLAN OF END OF COACH FITTED WITH AUTOMATIC AND SCREW COUPLERS

New Great Western Trains.

A FEW weeks ago two complete trains were added to the stock of the Great Western Railway. They work between South Wales and Paddington, and are particularly remarkable on account of the coupling appliances with which they are fitted. With the exception of the two van coaches, which have standard Great Western couplings and gangways at both ends, and two third-class coaches which have standard couplings at one end, to suit the vans, the train throughout is fitted with Buckeye automatic couplers and gangways. But since that might lead to inconvenience, standard screw couplers and buffers are fitted as well, and in order to obviate interference between the two gears, the automatic coupler and both the buffers are carried on hinges so that the coupler can be dropped down when the buffers are wanted, and *vice versâ*, as shown in the engravings on page 658.

With the Buckeye coupler is associated the corridor gangway. The bottom part of the frame of the concertina portion on each vehicle acts as a buffer beam and transmits the pressure to two powerful springs on each coach. The result of this arrangement is that the train, as a whole, becomes virtually a flexible tube, practically, from end to end, and there is, in consequence, greater flexibility when taking curves and less oscillation.

Through the courtesy of Mr. C. B. Collett, we are able to show a drawing of this very interesting arrangement, on which the parts to which we have referred will be readily recognised.

We may mention that a special feature of the four-wheeled bogies which are fitted under all the coaches is the suspension gear, which consists of two vertical bolts at each corner of the bolster placed as far from the centre as possible. Two spherical washers are fitted to each bolt to allow free movement of the bolster. The bolts are placed vertically in order to obviate the see-saw movement which results if inclined bolts are used.

New Switchgear.

AT the London office of Brookhirst Switchgear, Limited, Australia House, W.C. 2, we recently inspected some new and well-designed switchgear for alternating-current motors. The gear comprised "straight on" and star-delta starters of the wall and pillar types, and auto-transformer and rotor starters, both of the latter being of the pillar design. The wall type star-delta switch is shown in Fig. 1, the straight on switch in Fig. 2, the auto-transformer switch in Fig. 3, and the rotor unit in Figs. 4 to 6. By the adoption of the Brookhirst patented assembly case, the difficulties associated with the assembly of the component parts of complete oil-immersed motor control gears have been overcome. This case consists of a hollow steel frame upon which the various component parts are mounted, and through which the interconnections are taken, the arrangement giving a totally enclosed ironclad pillar comparable in every way with the firm's direct-current pillars. As the assembly frame is fitted with renewable back doors, the interconnections are very accessible, as shown in Fig. 5. Safety is obtained by the provision, in cases when it is required, of an insulating switch in the cast iron base of the pillar, and the handle of this switch operates in conjunction with the makers' patented gate interlock. Unless the isolating switch is in the "off" position the gate cannot be opened, and the covers of the starter and resistance or transformer cannot be removed. Moreover, the oil tank of the starting unit cannot be lowered. Conversely, the isolating switch cannot be operated until the gate is closed. The isolator is an air-brake switch, but the gear is designed so that the oil-immersed circuit breaker is automatically opened before this switch. It is frequently found objectionable in practice to introduce armoured cables into the bases of pillar control gears, on account of the large bend or sweep which the cable requires, and here, again, the hollow frame construction simplifies matters. Split connection boxes are fitted to these alternating-current pillars, and are fixed at the side of the assembly frame at a convenient height, so as to permit the cable to enter either from above or below. From these boxes rigid copper connections are run inside the frame to the control switches, and from these switches to a second connection box or second set of cable terminals for the motor leads. Whilst the connection boxes are designed primarily for armoured and lead-covered cables, they are suitable for any other kind of cables that may be employed.

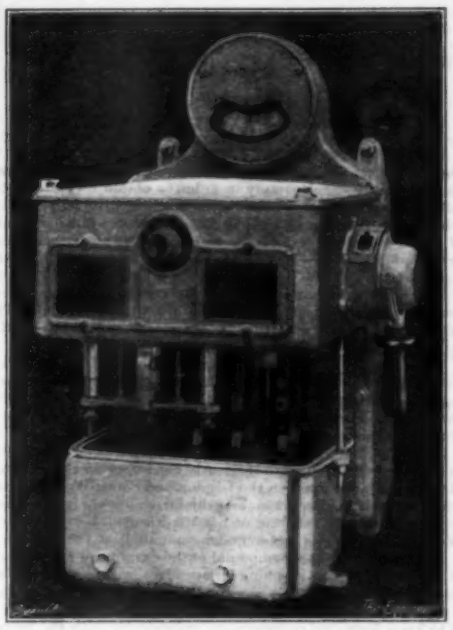


FIG. 1—STAR-DELTA WALL SWITCH

The ironclad starting unit is in all cases of robust design, and comprises a starter and circuit breaker, irrespective of whether it is of the "straight on" star-delta or auto-transformer type, the multiple switch being controlled by a Brookhirst patented ratchet handle, by means of which the circuit breaker is first closed and then the starting switches or the starting switch and auxiliaries are operated in the correct sequence, and with a slow step-by-step action. The components of the complete starting unit are practically identical in the different forms of starters for widely different currents and pressures. No spring-return action is necessary. Once the starting operation has been started it must be completed or the circuit breaker will be tripped, and it can only be re-set after the starting handle has been returned to the "off" position.

The circuit breaker is fitted with a no-volt release, and with either two or three overload trips, according to requirements. These are free to operate, either during starting or running and independently of the position of the rheostat handle. This feature, the makers point out, is particularly noteworthy in the case of "straight on," star-delta and auto-transformer starters by reason of the high starting currents which have in these cases to be taken into account. The designers of the gear have realised that the conditions incidental to these applications are not adequately met by rendering the overload devices inoperative during the starting period or by fitting them with time lags. Theoretically, the overload protection device should permit the required starting current to pass during the period of starting, and after this the normal full load current of the motor, plus a predetermined margin, depending upon the running conditions, and the restraining device fitted to these units fulfils these requirements. It restrains the overload trips from operating during the starting period, but if the required starting current is exceeded, the circuit breaker is released. The restraining gear remains in action until after the "run" position is reached, and therefore provides for any "run" peak current which may arise. Afterwards the restraint is automatically removed, and the overload trips are then free to operate at the particular overload current for which they have been set. The transformers of the auto-transformer unit are oil immersed, and are provided with adjustable tappings. They are fitted in a removable steel case, and are easily disconnected. The transformer can be bodily withdrawn from its case after removal of the top cover. In the case of rotor pillars, the resistances are either of the self-ventilated tubular type, or consist of iron grids. As a standard they are air cooled, but oil-immersed resistances are supplied when required. The ammeters are of the moving iron type, and are fitted in a cast iron hood with a glazed removable front.

Institution of British Foundrymen.

SEVERAL instructive papers in connection with foundry operations were read and discussed at the summer conference of the Institution of British Foundrymen, which was held in Manchester last week. Mr. F. A. Melmoth's paper dealt with steel castings of light and medium weight, and the author described the various operations involved in the production of such castings in large quantities. One of the novel appliances in connection with machine moulding which Mr. Melmoth described was the Beardsley Piper sand slinger, which the author has recently had the opportunity of observing over a fair period, during which it was used for several kinds of work. In this machine, prepared sand is fed into an impeller head by a conveyor belt, and is projected at the pattern by means of rapidly revolving blades. The machine, the author explained, is capable of ramming sand at the rate of about 10 cwt. per minute, and undoubtedly represents a marked step forward in the evolution of machine moulding. The question of facing sand represents some little difficulty, as obviously only one type of sand can be handled by the machine, but it is claimed that the ordinary backing sand can be kept in such condition as to be perfectly satisfactory on the face of the mould. The author feels, however, that it is too early to make any very definite statement regarding this machine, but states that should its claims be fully substantiated, there is no doubt that as a means of producing moulds for castings of a medium weight it will occupy a very prominent position in the future.

The use of machines of any type, makes, continued Mr. Melmoth, a very heavy demand on the core shop, and in order to cope with it, machines to make cores will have to keep step with the advances in moulding machine practice. Both jolt-ram and squeezer machines are in use for this purpose, but the author considers that the attention paid to the machine production of cores is still far behind that paid to machine mould production.

A paper on "The Manufacture of Steel Castings in the United States," by Major R. A. Bull, dealt in a comprehensive manner with a very large subject. The author said that despite the tremendous growth of the electric furnace industry in recent years in the States, there was

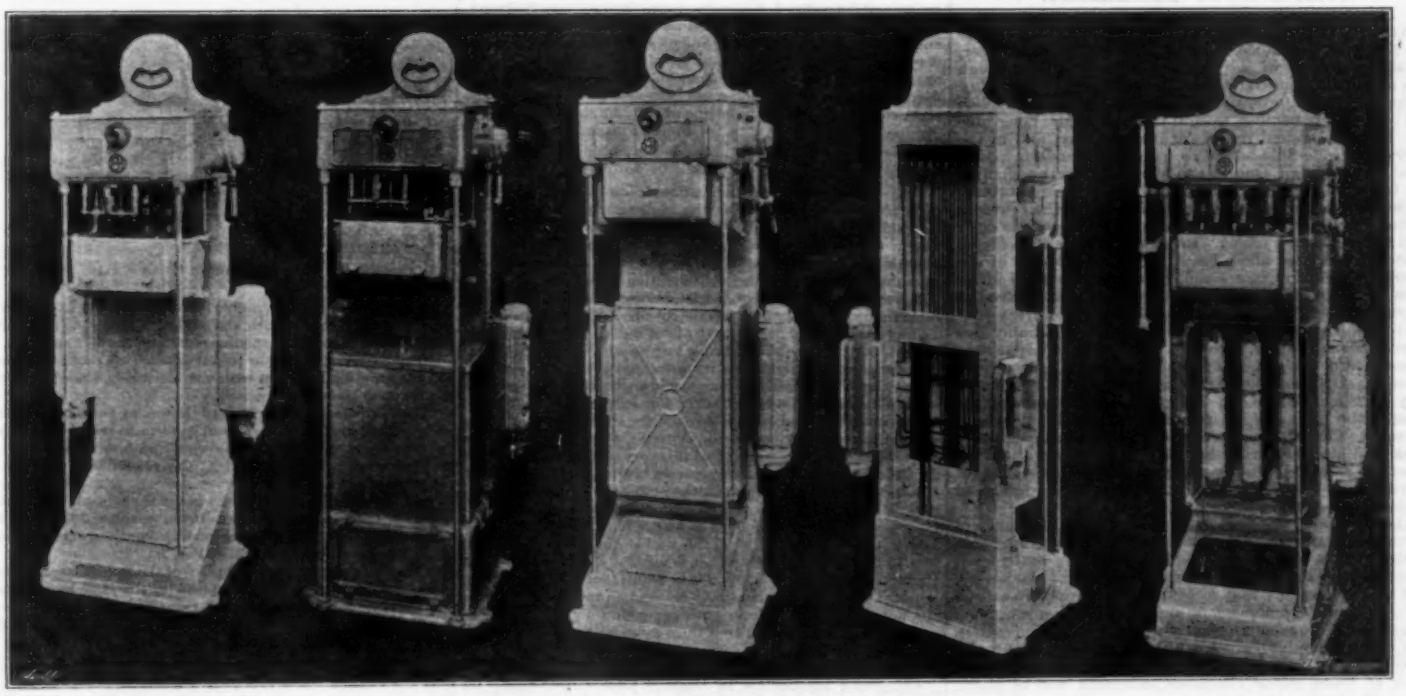


FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

no reason now to suppose that the tonnages of open-hearth steel castings annually made in America would soon be appreciably reduced beyond present production. While the better suitability of the electric furnace was gradually becoming demonstrated for certain castings heretofore produced in greater or less degree from the open-hearth, the constant development of new uses for all kinds of steel castings would probably compensate for tonnage losses sustained by open-hearth foundries in preferred manufacture elsewhere of part of the total product. Considering quality and cost, said Major Bull, the open-hearth is admirably adapted for the major portion of the tonnages of steel castings made in America.

A paper on "Carbon in Foundry Irons" was contributed by M. Siegle, Professor of Metallurgy at Nancy. This paper was presented on behalf of the Association Technique de Fonderie de France. The author said there was a danger of putting too much faith in the carbon analyses of new irons making up the charge in the cupola. He said that a foundry dealt with such a variety of material that even a complete analysis of the new iron would not prove of the greatest benefit unless the composition, in carbon, silicon, manganese, phosphorus and sulphur, of all the remelt which quite often went to make up the charge was also known. For the intensive production of identical objects, or for the manufacture of such specialised articles as chilled rolls, complete analyses of materials were, he continued, advisable, if not indispensable. There were, however, other cases in which the customary practice of classification by appearance of fracture of both pig and remelt would be sufficient, especially if combined with a knowledge of the phosphorus content. It would, at any rate, be very difficult to replace those methods in actual practice.

In a paper on "Oil-sand Cores and Binders," by Messrs. A. Campion and J. McEachen, the authors gave the results of a series of tests which they have carried out in the laboratory and foundry. The authors' experience has been that many of the binder materials on the market show a marked want of uniformity in consecutive consignments and many failures have resulted from this cause. The experiments have all been carried out with a river sand. It is frequently stated that 450 deg. to 500 deg. Fah.—230 deg. to 260 deg. Cent.—is the correct temperature for the drying of oil-sand cores, but the authors, after many trials, have found that better results are obtained if the temperature is kept below 400 deg. Fah. —205 deg. Cent.—and that in most cases 300 deg. to 350 deg. Fah.—150 deg. to 175 deg. Cent.—gives the best results. The length of time at which the cores should be maintained at the desired heat depends upon the size of the core, but in general it is preferable to allow a more prolonged heating at the lower temperature than a shorter time at the higher limit. The authors' experience has been that most of the materials appear to give weaker and less satisfactory cores when baked at temperatures about 350 deg. Fah., whilst those that do not lose strength become less permeable to gases owing to a deposition of fine material in the pores, thus spoiling the venting properties.

ACCIDENTS TO MACHINERY.

We have just received from the British Engine, Boiler and Electrical Insurance Company, Limited, of Manchester, an advance copy of its technical report, and although it is no longer from the pen of Mr. Longridge, it is full of interesting and informative material. It is, as our readers will no doubt remember, several years since Mr. Longridge last wrote an annual report for his company, and in the interval considerable advances have been made in power plant engineering. One of the most noteworthy changes has been the great increase in the size of steam turbine-driven electric generating sets, and in view of their present paramount importance, this class of prime mover is dealt with first in the new report. Brief descriptions of accidents to steam turbines, which have come to the notice of the insurance company, are given, together with the conclusions as to the cause of the mishaps which were arrived at by its engineers. In this connection it is noteworthy that the reaction type of turbine appears to be remarkably free from accident, and that even if a machine of this type does experience a mishap, it does not result in very serious damage. On the other hand, it is evident that not so very long ago—dates are not given in this part of the report—the designers of impulse turbines did not fully appreciate the conditions under which their machines would work and did not properly take into consideration the effects of resonance on the rotor discs when they were set in vibration, and the possibility of their being fractured through its agency.

The accidents to steam engines and pumps which are chronicled in the report do not differ materially from those of the past, a fact which would be naturally anticipated in view of the long experience with this class of machinery, and it is noteworthy that most of the failures were caused either by the development of incipient cracks during long service or by the accumulation of water in the cylinders. In two cases of engines which had been running for fifty or more years the accidents only affected the fly-wheels and were of quite minor character, although one of them, originally designed for a steam pressure of 90 lb. per square inch, had been altered to work at 200 lb. pressure.

In the section of the report dealing with economisers there are several instructive accounts, including one in which the cast iron pipes had corroded away internally to a thickness of only $^1/_{16}$in. of metal, but nevertheless appeared full size on account of the adherence of the corroded metal. The trouble was put down to the use of a boiler compound containing ingredients liable to hydrolise.

Among the boiler explosions referred to, one of the most novel is that of a little vertical tubular boiler, 9½in. in diameter by 2ft. 8in. high, made of No. 14 W.G. steel plate and worked at about 60 lb. pressure. The vertical joint in the shell, which was the one that failed, was made by butting the edges of the plate and welding on an outside strap 1in. wide by $^3/_{16}$in. thick with the oxy-acetylene blow-pipe. The boiler withstood a hydraulic test of 220 lb. per square inch, but the welding of the seam was evidently defective.

Abstracts of the Board of Trade reports on boiler explosions are given from 1916 to 1921 inclusive, so that there is a gap of five years between Mr. Longridge's last report of 1910 and the present issue; but there is a brief catalogue of the accidents which happened in the intervening years.

The report, which is published from the company's offices at 24, Fennel-street, Manchester, price 10s. 6d., should be included in the library of every power plant engineer.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DESIGN FOR AN EXPRESS LOCOMOTIVE.

SIR,—Referring to Mr. Dauncey's letter in your issue of June 1st, page 574, it goes without saying that recourse is had to six-coupled wheels simply in order to obtain a greater total adhesion weight than is ordinarily possible with four-coupled wheels. If, therefore, by placing the inside and outside cranks of a four-cylinder 4–4–2 engine at 135 deg., as suggested in our first communication—May 11th, page 506—we are able to get the equivalent of over 60 tons for a total two-axle load of 45 tons, then surely the argument that six-coupled wheels are absolutely essential for timekeeping purposes falls to the ground. The adhesion in question, 45 tons, is possible owing to the special four-cylinder crank arrangement.

The objections to the employment of three or four separate sets of valve gear in the case of the Stephenson motion are, perhaps, justified when the space available is considered; but they do not necessarily hold good in respect to the Walschaerts gear, which can usually be easily accommodated.

As to the impracticability of using cylinders as large as 25½in. in diameter, Mr. Dauncey apparently has forgotten that the late Mr. Wm. Adams, when on the London and South-Western Railway, fitted a 26in. (low-pressure) cylinder outside the frames when he converted No. 446, one of his 7ft.-wheeled 4–4–0's, into a Worsdell-von Borries two-cylinder compound in 1888.

It is true that some compound enthusiasts have looked only at the coal bill; but, speaking for ourselves, we are not confining our attention to that one aspect of the question. At the same time, everyone knows that the aim of all locomotive engineers is to keep down fuel consumption, consistently with the proper working of the passenger, goods and mineral services. The general adoption of superheating is an unanswerable proof of this contention.

Mr. Dauncey says that for a given power, four-cylinder compounds cost more to build than do three-cylinder simples. That may be so, but there are many four-cylinder non-compounds running in this country, the difference in cost between which and a compound type of greater power and efficiency might well be warranted by results. To-day, in order to obtain fuel economy, the simple engine must be well notched up, the consequence being that whatever be the total piston area, the potential power of the engine is utilised to only a comparatively small extent. If compounding were correctly applied a larger proportion of the available power in the steam would make its appearance at the draw-bar, as is ostensibly the case on the Continent.

What undoubtedly is a good example of a modern four-cylinder compound is a recent 2–8–2 engine on the Italian State Railways. This engine has a pair of high-pressure cylinders 19in. in diameter and a pair of low-pressure cylinders (placed outside) 28in. in diameter, all with a common stroke of 26½in. These cylinders are larger than we could use here, but this example shows the degree to which compounding has been developed abroad. The eight-coupled wheels of the engine are 6ft. 2in. in diameter.

June 15th. F. W. AND A. J. BREWER.

SIR,—Notwithstanding the various reasons advanced from time to time to account for the unpopularity of locomotive compounding in England, I am personally still of the opinion that it is capable of being applied in a successful manner, and I entirely agree with Messrs. F. W. and A. J. Brewer that the question is worthy of further consideration here.

A compound locomotive can be designed to give practically a maximum tractive effort with a cut-off of 30 per cent. in the high-pressure cylinders, up to the limit of the engine's adhesion weight. A corresponding simple engine of the same nominal cylinder capacity would exert its maximum power with a cut-off round about 75 per cent.—that is, at starting or when ascending a steep incline with a heavy load. For fast running the simple engine must be linked up, and if we put the cut-off under ordinary express speed conditions at 30 per cent., it is obvious that the tractive force of every simple engine is very substantially reduced by the common but necessary process of shortening the cut-off. If a later cut-off is made use of, the power is increased; but so, also, is the consumption of coal. On the other hand, if a compound can be made to deliver at 30 per cent. cut-off, the same power as is obtainable with the simple engine at something like 70 to 75 per cent. cut-off, it is evident that the maximum tractive effort of the compound is available, not only at starting, but also at all the speeds usually reached on the road. That is, the adhesion being alike in both compound and simple. The engine which I converted to a three-cylinder compound on my own system in India some years ago did, in fact, do all the work that was required from it with a 25 to 30 per cent. cut-off.

Compound locomotives in England have failed chiefly for the reason that the high-pressure cylinders have been made too small, and the engines have been less powerful than the competing simples. I see no reason why the cylinder dimensions suggested by Messrs. Brewer, viz., high-pressure 17in. by 28in. and low-pressure 25½in. by 28in., should not be practicable.

There is, however, another way in which the power of the locomotive could be vastly augmented, and that is by adopting unusually high steam pressures from 750 lb. to 1000 lb. per square inch, in a boiler of the flash type. This boiler could not only be used with absolute safety, but could be employed without encroaching on moving dimensions. Further, the fire-box stay trouble would be got rid of, and the cost of repairs, as compared with the present type of boiler, would be greatly reduced. The engine would necessarily be a compound, so as to take the fullest advantage of the very high pressure mentioned.

The question of greater power is partly one of cylinder diameter and partly one of effective pressure on the pistons, and if these two factors are combined and calculated so as to use up the adhesive weight with a 30 per cent. cut-off in the high-pressure cylinders, it will be found that the maximum tractive effort of the engine will be available at high, instead of as at present, only at slow speeds, and will, moreover, be developed in a really economical manner.

Brockley, S.E. 4, June 15th. JOHN RIEKIE.

RAILWAY SPEEDS.

SIR,—The leading article on "Railway Speeds" in your issue of June 8th must, I am sure, have been read with great disappointment by all who are interested in progress in the railway world.

Surely, Sir, the main object of railway transportation is to secure the highest speed that is consistent with punctuality. Can it be contended seriously that this has already been attained and that no further advance is to be hoped for? The tone of your article suggests that this despairing conclusion is, if not reached, at any rate in sight. But I doubt if those responsible for either the management of any progressive railway or for its motive power will agree with you. On the contrary, inquiry will show, first, that accelerated services not only attract, but augment traffic, and thus pay; secondly, that the fastest trains keep, on the whole, the best time; and finally, that a material enhancement of all-round speed is feasible with existing British locomotives, at no detriment to punctuality.

It is further to be borne in mind that increased journey speed diminishes the occupancy of the running roads, and may, where the latter are crowded, enable a larger number of trains—goods as well as passenger—to be run.

The line of argument adopted in your leader would apparently amount to a declaration that for passenger transportation railways have reached their limit of utility. The same foreboding was expressed in the 'forties, when the standard gauge failed to achieve the same end-to-end speeds as the broad gauge; yet to-day speeds on the standard gauge exceed anything the broad gauge attained. I venture to suggest that a similar falsification awaits your present views, which, if applied to any of the older branches of engineering, would put an end to progress.

London, June 13th. HORACE MYERS, Major.

AN INTERESTING GEAR.

SIR,—I am enclosing a short description of gears that mate together, but run in the same direction. A model of brass plate has been made, and they work quite well, though their practical application is perhaps doubtful. As considerable interest and some amusement has been shown in the idea, I thought you might care to publish it. It is original as far as I know.

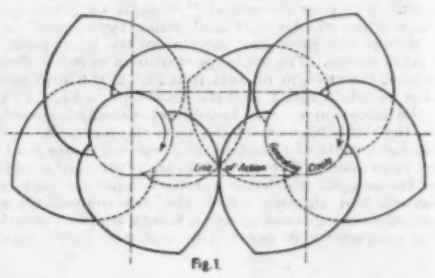


Fig. 1.

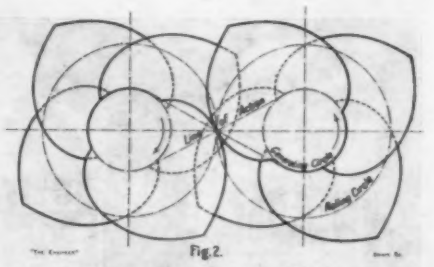


Fig. 2.

A UNIDIRECTIONAL GEAR TRAIN.

The analogy of the crossed belts on two pulleys to explain the action of the involute tooth, the pulleys representing the generating circles and the belts the line of action, is well known.

It occurred to the writer that if gear wheels could be designed on the same analogy, but with uncrossed belt, the wheels would both run in the same direction.

The result is shown in Fig. 1. It was at once apparent that step gears or helical gears would have to be used on account of interference; also that sliding would be considerable.

The pressure angle is 90 deg., the wheels both being of the same hand.

If the "hand" of one of the gears is changed, thus making them of opposite hand, it is as if the imaginary belt had been crossed; the wheels then become ordinary gears and run in opposite directions, as shown at Fig. 2.

If helical gears were used in place of the step gears, apparently one tooth pinions of fairly long lead, of the same hand of helix, would mate together, turning in the same direction.

Birmingham, June 18th. F. E. LINDSAY.

THE Federation of British Industries has applied to the Railway Rates Tribunal for an order to compel the Great Western Railway Company to reduce its rates to 33⅓ per cent. above the pre-1917 figure. The gist of the Federation case is understood to be that, even if it is true that the financial results of the reductions already made do not justify further reductions, the hindrance to trade from the high charges is so great that the companies should be required to draw on their reserve funds for the purpose. We would add that the selection of the Great Western as the company to be attacked will, in one direction, be of benefit to the companies generally—its accounts have been less confused by grouping. On the other hand, it is the most prosperous of the groups. We have seen it said that Sir Eric Geddes, when speaking at Manchester on March 27th, demanded that rates should be reduced to the standard above named. That is not so; Sir Eric was, we noticed, particularly careful not to commit himself to any figure and only named 33⅓ per cent. above pre-war as being desirable.

Railway Matters.

FROM July 9th the Great Western will have thirty-three daily non-stop runs varying from 85 miles to 225¾ miles.

THE revenue of the Chinese Government Railways during 1922 amounted to 98,130,806 dollars Mex., as compared with 95,218,000 dollars Mex. in 1921. The corresponding expenses were 57,895,297 dollars and 52,503,000 dollars respectively.

THE locomotive workshops at Darlington and Gateshead are both under the managership of Mr. R. A. Copperthwaite, who has his office at Darlington; the carriage and wagon works at York, Shildon and other points, are under Mr. E. Thompson, also stationed at Darlington.

A COLLISION occurred in Carlisle Station on Thursday morning, the 14th inst. The train that left St. Pancras at 9.15 p.m. for Edinburgh, Waverley, was run into by the Glasgow express that left the same station 15 min. later. There was little personal injury, but some carriages were derailed.

THE Great Western station at Aberystwyth is to be improved at a cost of £100,000, and substantial alterations are to be made at Barmouth. The late general manager of the former Cambrian Railway is said to have told Mr. Pole that he would find the Cambrian coast a veritable gold mine. It looks as though there was some truth in this remark.

THE headquarters of the Pennsylvania Railway are at Broad-street Station, Philadelphia, and it will be interesting to hear in detail what damage was done by the fire last week. The station is not a modern building. It has sixteen tracks and a remarkable series of cross-over connections outside, whereby the fullest use is made of the platform accommodation.

THE land and estate department of the London, Midland and Scottish Railway has now been organised. Mr. J. R. Ball becomes the land and estate agent, with office at Euston, having Mr. F. J. Stannard as his assistant. There are four divisional land and estate agents, and they are:—Messrs. J. R. Worrall, London; W. H. C. Clay, Derby; J. M. Williams, Manchester; J. Fulton, Glasgow.

A FEATURE of the Great Western summer service that will come into operation on the 9th prox. will be the timing between Swindon and Paddington of the 2.30 p.m. express from Cheltenham. This train will continue to leave Swindon at 3.45, but will be due at Paddington at 5 instead of 5.10, and so will cover the 77¼ miles start-to-stop run in 75 min., or an average speed of 61.6 miles per hour.

THE Great Western Railway Company obtained powers in 1905 to build a new line between Oxley, just north of Wolverhampton, and Bridgnorth on the Kidderminster–Shrewsbury line, 15 miles in length, with a branch, 4 miles long, thereof to Kingswinford. The work, after £68,000 had been spent, was necessarily stopped during the war, but it has now been decided to proceed with and complete the portion between Oxley and Kingswinford Junction.

QUITE a good point was made in the letter of protest sent by the Railway Stockholders' Protection Association to the Railway Companies' Association on the subject of further reductions in rates. It was that the rates remained unaltered during the war period, "with the result that traders were subsidised by the State and thereby enabled further to swell their war profits, while railway stockholders had to be content with pre-war dividends, and sometimes less, during the war."

IT is reported that for the electrification of the railway between Stockholm and Gothenburg the single-phase alternating-current system has been adopted. The work of conversion is to be started immediately in the vicinity of Alingsaas, and it is calculated that it will be completed in two years. It is understood that though most of the orders for material and equipment, including one for fifty locomotives, will be given as far as possible to the home industry, a not inconsiderable proportion will go abroad, much copper, for example, having to be imported. After the electrification the journey will only occupy seven hours, compared with nine at present.

EXCEPT that each section still retains its former general manager, the organisation of the Southern Railway is now complete. To fill the vacancy caused by the unfortunate death of Mr. J. J. Brewer, Mr. Godfrey Knight returns to Waterloo, but as secretary to the combined company. Mr. A. W. Szlumper is the chief engineer, and Mr. G. Ellson goes from the South-Eastern as deputy chief engineer. Mr. R. E. L. Maunsell is the chief engineer for locomotives, carriages, wagons and road vehicles; Mr. S. Warner is the assistant mechanical engineer for carriages, wagons and road vehicles, and Mr. A. H. Panter the deputy assistant. Mr. Herbert Jones is the electrical engineer, and Mr. H. Richards goes from the Brighton to be assistant electrical engineer. Mr. G. S. Szlumper becomes the docks and marine manager for the group, Mr. E. C. Cox the chief operating superintendent, and Mr. A. D. Jones the running superintendent.

THE recent retirement of Mr. Leonard Archbutt from the position of chemist to the Midland Railway Company reminds us that, after the fatal collision at Carlisle in March, 1890, due, it was alleged, to the vacuum brake on a London and North-Western train having frozen, that gentleman and Mr. R. M. Deeley, the Midland locomotive superintendent, contributed two articles to this journal. They were entitled "The Thermo-dynamics of the Automatic Vacuum Brake," and appeared in the issues of THE ENGINEER for June 27th and July 11th, 1890. Whilst the articles were highly technical they clearly proved to the lay mind, by theory and practical experiment, that the automatic vacuum brake was essentially a dry brake, and that any water which gained access to the interior could only be condensed steam which had leaked from the ejectors used to create the vacuum. It was further observed that "there can be no question but that it is possible by proper arrangements to prevent the leakage of steam into the pipes, and such being the case, we have regarded it as being of the utmost importance that the mistaken ideas which prevail regarding the supposed condensation of atmospheric moisture should be shown to be fallacious."

Notes and Memoranda.

AN experimental launch which has recently started service in the Hangchow district of China, is equipped with a gas engine and producer, but it is too early to say yet whether this type of machinery will be suitable for attendance by native boatmen.

AT a meeting of Bruksocieteten, recently held at Stockholm, the possibility of producing iron in Norrbotten from Lapland ore was discussed. It was pointed out that the construction of new works for producing rolled iron and steel for home consumption would not pay. On the other hand, the opinion was expressed that cheaper pig iron might be obtained from works situated in Norrbotten.

THE works of the Belgian company at Oolen, near Antwerp prepare 3 grammes of radium per month, and this production can be increased, if necessary, to 6 grammes; thus a yearly output of 36 to 72 grammes. The chief source of radium is, of course, the ore which is extracted from mines in the Belgian Congo, which yields 100 to 175 milligrammes per ton, while that of America is said only to yield 5 milligrammes per ton.

IN discussing the paper on the use of oxygen in gas making, which Mr. T. C. Finlayson recently read before the Institution of Chemical Engineers, the *Chemical Trades Journal* remarks that the cost of oxygen for the purposes for which it is at present mainly applied cannot be considered prohibitive, but its uses would be increased manifold could it be produced at the price that its free abundance in the atmosphere would at first sight seem to warrant.

COMMENTING on the claims of American and German manufacturers as to the purity of the ammonia they produce, the *Chemical Trades Journal* remarks that the American commercial product contains less than 0.1 per cent. of impurities, and the German brands slightly more, but that by elaborate processes conducted in the laboratory the impurities could be reduced to 0.013 per cent. As a contrast it is noteworthy that a British factory is producing commercial liquid ammonia of 99.995 per cent. purity.

A NOVEL form of hydraulicing has been adopted on the Vaal River diamond fields, where, according to the *S.A. Mining and Engineering Journal*, a large fire engine of high power and big capacity, with four nozzles, purchased in Capetown, will be employed in the removal of silt or overburden lying on what is believed to be exceedingly rich diamondiferous alluvial. The gem-bearing alluvials at this point are overlaid by from 20ft. to 50ft. of overburden, and it is proposed to deal first of all with the ground in the vicinity of the Vaal.

SOME experiments carried out in America have shown that by using a special form of antenna, the audibility of wireless signals could be increased by nearly 40 per cent. The conductor is composed of ten strands of No. 18 bare copper wire braided closely together on a special machine to give it a ribbon-like appearance, ¼in. wide by ⅛in. thick. With an antenna 30ft. long of this type, strung in a basement at a level about 1ft. below the surface of the earth, better results were obtained than with an antenna of the usual type, of 100ft. length, strung between two poles out of doors at an elevation of about 40ft.

THE Nerbudda Bridge, at Akbarpur, the opening of which we have already announced, has a length 2193ft., or nearly half a mile, and consists of 59 spans of masonry and concrete of 30ft. each. Abutment piers are placed at every sixth span, so that in case of damage by flood or collision to one span, the maximum collapse that could take place would be a series of five arches. The road level is at an average of 25ft. above bed level, and the maximum height is 30ft. The highest flood level known was 55ft. above bed level; therefore, on such occasions, there will be 25ft. of water above this bridge, but these floods are generally of short duration.

ACCORDING to the *Iron and Coal Trades Review*, a plan for electrifying industries in the United States at a cost of £1,000,000,000 has been reported to the New York Convention of the Electric Light Association. A system of 220,000-volt transmission lines a few hundred miles apart, spreading over the entire United States, is proposed. The system to be used, according to the inventor, a San Francisco engineer, is a constant voltage one, the voltage control and regulation being accomplished by means of synchronous regulators or condensers placed every 100 or 200 miles along the transmission lines. The water power from Canada to Mexico and from the Atlantic seaboard to the Pacific would be used to generate electricity.

AN etching re-agent for alloy steels, by means of which chromium carbide can be distinguished from vanadium carbide, comprises a hot solution of potassium permanganate and sodium hydroxide, which, in one minute darkens chromium carbide to a strong brown-red or brown colour, or, rather, the carbon is eaten out, giving the walls of the cavity thus formed a dark brown-red colour, whilst vanadium carbide remains uncoloured and apparently unattacked. Another but less positive means of distinction is that obtained by electrolytic etching with a weak current in a dilute aqueous solution of ammonia or sodium hydroxide. The chromium carbide is eaten out, leaving a dark brown-red or brown cavity, whilst the vanadium carbide is eaten out apparently at a slower rate, leaving cavities which appear light and not at all darkened.

THROUGH investigations conducted by the United States Government technologists, methods of detecting carbon-monoxide poisoning have been greatly simplified. For some time past the United States Bureau of Mines has been conducting research work with the result that means have been found by which it is possible to discover within 3 min. the extent to which a person has been affected by carbon monoxide through the extent of poison saturation in the blood. Formerly it took about twenty-four or forty-eight hours before diagnosis could be made of such cases either in hospitals or well-equipped laboratories with the services of a skilled organic chemist. The test is now effected through a simple and inexpensive instrument which may be carried in the pocket, and which requires no special training for its use.

Miscellanea.

THE South African Mint is now in a position to coin the precious metals.

REGULAR communication by means of radio-telegraphy has been established between Bulgaria and Moscow.

A FRENCH "trade ship," of about 11,000 tons register, is being organised for a voyage round South America this autumn.

THE new coaling plant at Delagoa Bay, Portuguese East Africa, was officially tested last month, and has been put in commission for coaling steamers calling at the port.

THE Military Governor of Kiangsi has telegraphed to the Chinese Cabinet reporting his plans for the opening of a new Yangtze port at Kiukiang, utilising the public land at Lung-kai-ho and Ping-hsin-chow and the adjoining private grounds for the purpose.

A SCHEME is in hand for utilising the Snowy River in Australia for generating electricity. A dam will be built below Jindabyne, 150ft. in height, and will provide a flow of 1100 cubic feet per second. It is estimated that the total power obtainable is 200,000 horse-power.

TWO Chicago engineers, L. K. Sherman and E. C. Phillips, have a scheme for regulating the levels of Lakes Huron and Michigan, the proposition being put forward by the city of Chicago. It is proposed to build submerged dams at the entrance of the St. Clair River.

THE Saghalien Administration has under contemplation the establishment of a mining company with a capital of £6,000,000, one half to be raised by subscription and the other to be provided by the Government. The object is to develop the coal resources of the island, which have been estimated at 8000 million tons.

SOME Chinese capitalists are organising an extensive aeroplane service for passengers and goods, which will extend throughout a large part of the country. The routes proposed are Tientsin–Urga, Hankow–Woosung, Peking–Hankow, and Fukien–Formosa. Six aeroplanes have been imported from America for starting the scheme.

IT is understood that a company is to be formed to work the iron ore deposits about 50 miles from Colombo, where an area of 80 acres is estimated to contain 200,000 tons of iron ore. Samples of the ore examined by the Ceylon Government Analyst and the Imperial Institute, London, show that the deposits are well up to the standard of ores in other countries.

THE new plant which the Hamilton By-Products Coke Ovens, Limited, is erecting in Ontario is intended to be in operation by November 1st. When completed, the plant will have a minimum capacity of 5,000,000ft. and a maximum capacity of 7,000,000ft. of gas a day. The coke, which will be obtained as a by-product, will amount to from 300 to 350 tons a day.

PROBABLY the largest piece of forestry planting accomplished during recent years in China is in Tsingtao. This covers an area of about 7000 acres, and is now in an advanced stage of growing. It was started by the Germans, maintained by the Japanese, and has just been given to China. A Chinese forestry expert is now in charge. It is expected to make this a model plantation for all China.

IN a recent contribution to the *General Electric Review*, Mr. H. A. Butler discusses the cost of public lighting. Few people realise that the expenditure on the lighting of highways forms but a small part of the total cost of upkeep. Mr. Butler presents diagrams showing that the running cost of lighting, on a method described, works out to about 10 per cent. of the maintenance of reinforced concrete roads, bituminous macadamised roads, and even less in the case of those made of reinforced concrete.

THE plans and specifications connected with a proposal to extend the deep-water berthage at the Main Wharf, Port Natal, were recently submitted to the South African Parliament. They show that the new accommodation will suffice for one of the largest of modern vessels and two smaller ships, the depth at low water spring tide being 40ft. It is understood that the scheme makes provision for berthing any shipping which may have to be disturbed as a result of the construction of the additional berthage.

IT is expected, states the *Electrical Review*, that the new studio for the Birmingham broadcasting station will shortly be completed. It will be near the Summer-lane power station. The new studio will permit of much better programmes being transmitted, for hitherto it has been difficult to persuade artistes and bands to make the long journey out to Witton, which is on the city boundary. The Summer-lane studio will be more or less centrally situated, and it is proposed to connect it by land line to some of the places of entertainment in town, so that performances may be broadcast occasionally from these centres.

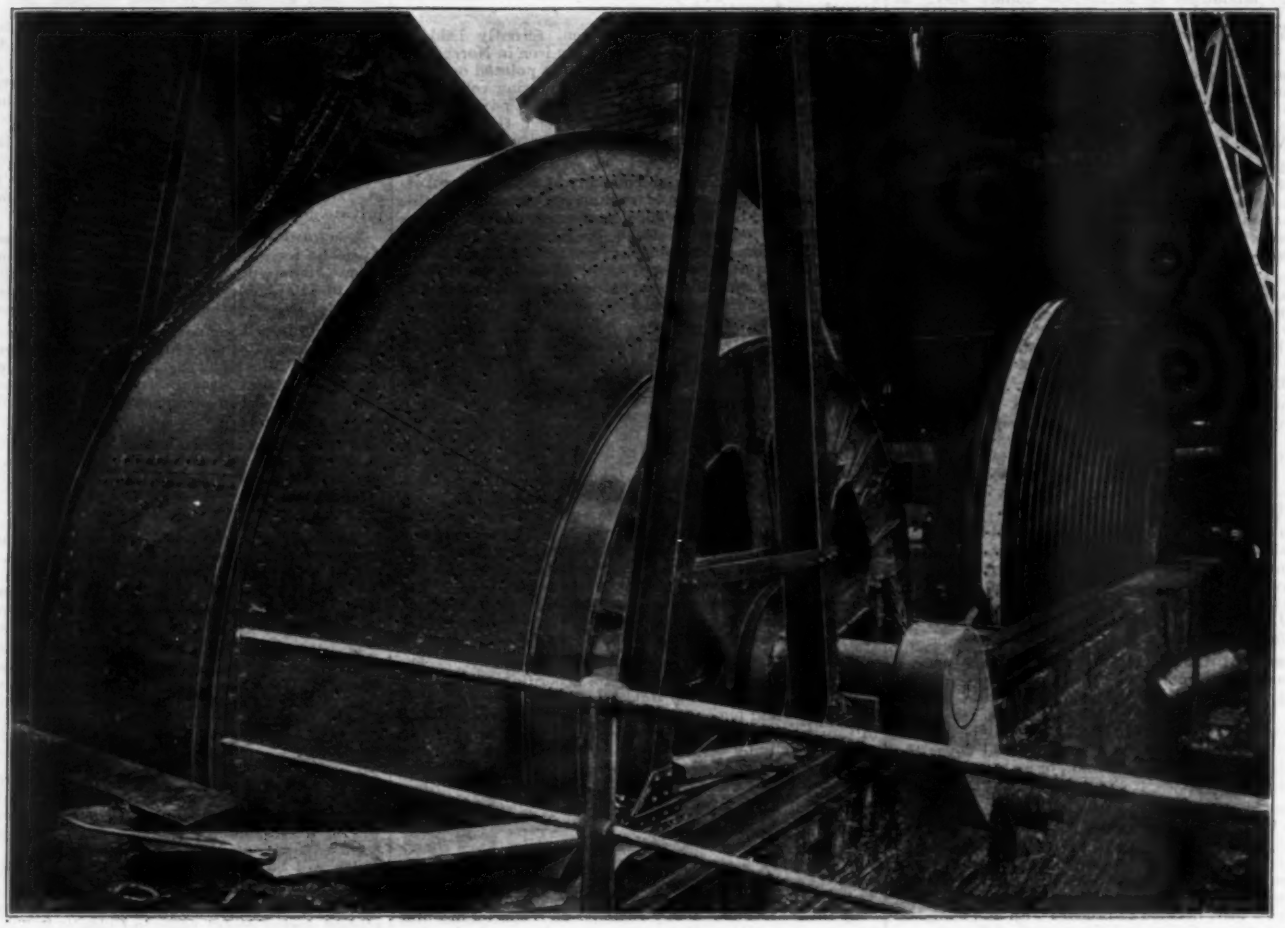
THE United States produced petrol at the rate of 20,634,756 gallons per day during the month of April, thus establishing a new record. The nation's stock of petrol on May 1st, amounted to 1,336,417,871 gallons, while the consumption during April amounted to 474,187,507 gallons, an increase of approximately 42 million gallons over March and of 80 million gallons over April, 1922. The production of paraffin in April is reported to the Bureau of Mines as having been 181,948,359 gallons, a decrease of 7 million gallons from the corresponding month last year. Stocks on May 1st amounted to 273,005,180 gallons.

IT is proposed by a military official in Shansi, China, to construct a good highway between Paotowchen and Sinkiang, a distance of upwards of 1600 miles, for transportation by long-distance omnibus of the Russian type. According to his plan, a station is to be established at a distance of every 24 miles, at which the horses, and not the omnibuses, are to be changed. Such an omnibus, it is said, can travel 240 miles in twenty-four hours. Capital is being subscribed in Shansi for the above purpose. Construction will be completed in three years. Good roads in Shansi, to a distance of more than 800 miles, have already been constructed under the supervision of the promoter. The construction has been approved by the Military Governor of Shansi.

NEW WINDING DRUM AT THE BERTIE PIT, TREHAFOD

ROBEY AND CO., LIMITED, LINCOLN, ENGINEERS

(*For description see page 670*)



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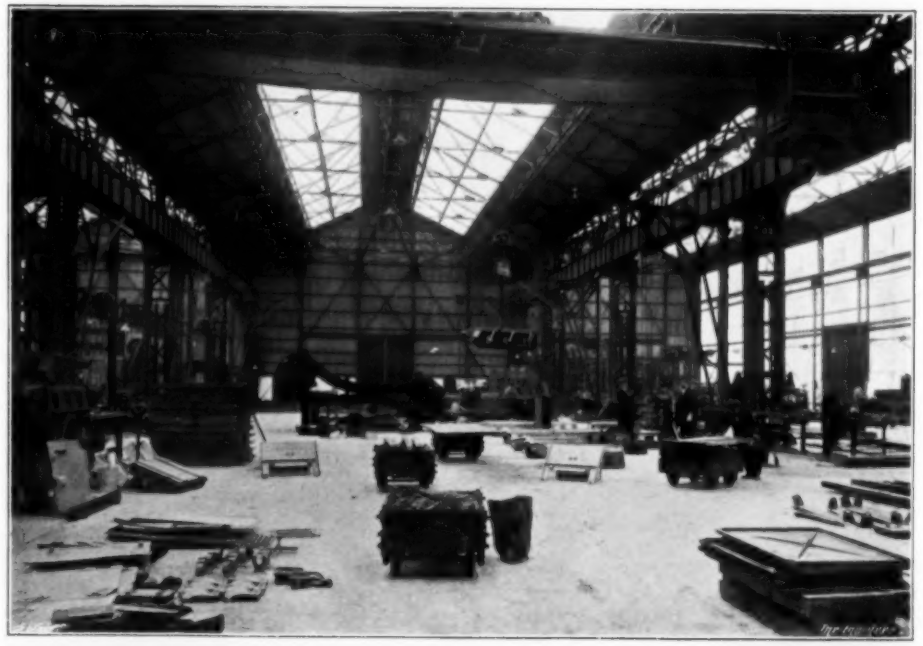

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TWO-PAGE SUPPLEMENT—THE WORKS OF THE INTERNATIONAL COMBUSTION ENGINEERING COMPANY, LIMITED, DERBY.

DEATH.

ON June 18th, at King's College Hospital, RALPH STRACHEY, late Chief Engineer of the East Indian Railway, son of the late Lieut.-General Sir Richard Strachey, G.C.S.I., aged 54.

THE ENGINEER.

JUNE 22, 1923.

The International Air Congress.

THE Air Conferences organised by the British Air Ministry, the third of which was held at Guildhall last February, are intended to be domestic affairs, and are designed to promote the progress of both civil and military aeronautics. The International Air Congress which opens on Monday of next week at the home of the Institution of Civil Engineers will, on the other hand, be attended by some five hundred members representing seventeen different countries, and will exclude from its purview any purely military aspect of the aeroplane or airship. It is a semi-Government function, in so far that it is being held in this country at the invitation of our Government, expressed through Sir Frederick Sykes at the preceding Congress held at Paris in 1921. Moreover, not only is the Air Ministry largely represented on the Main Committee, but on the General Council are representatives appointed by the Admiralty, War Office, Ministry of Transport, Colonial Office, Department of Scientific and Industrial Research, Post Office, and other Government Departments. What, it may be asked, is the necessity for an *international* air congress, and why should our Government go to the trouble and no doubt expense involved in assisting in its organisation and in supporting it? With five hundred members drawn from all the principal countries of the world, Germany excluded, it is obvious that it will be impossible to discuss many important developments in aeronautics which are still regarded by the Powers concerned as confidential or secret. It is unlikely, for instance, that, with the whole world listening, our Government will permit the revelation at the Congress of the results obtained to date by Mr. Brennan with his helicopter or of those accumulated by its own and other British experimenters with crude oil aero engines. Foreign representatives will be similarly tied as to what they may and may not disclose. Is the residuum of general, open subjects or of subjects having a definite international bearing sufficiently important to warrant our participation, as a nation, in the Congress?

It may be at once admitted that the great bulk of the detailed progress now being made in aeronautics is being made secretly, and that so long as the military side of the science and practice of artificial flight remains, as it easily is to-day, the dominant aspect, so long will the preservation of secrecy in development work be essential in many important directions. Military aeronautics can therefore be benefited by the Congress only in an indirect manner, in so far, in fact, as the information revealed is applicable to all branches of flight. Since such information will be open to all, its relative value to any one country will depend upon the capacity of that country to utilise it. In this respect, it may be said that even to-day, both as regards ability and desire to utilise new information and adopt fresh ideas, Great Britain, officially and privately, is surpassed by no other aerial Power. With this knowledge we would view the Congress with considerable satisfaction from the purely military point of view, were it not for the fact that of the sixty papers to be presented at it, more than half are to be contributed by British authorities, and the rest by representatives of the sixteen other nations taking part in the meeting. It would appear, then, that the chances are greatly in favour of our benefiting foreign military aeronautics more than the foreign representatives benefit ours. The significance of this reflection is heightened when it is observed that while the foreign authors will contribute largely to the proceedings of the sections discussing abstract general matters, such as the comparison of model data and the graphical treatment of the equations of flight, and of the sections dealing with such subjects as meteorology, the international regulation of air transport and aerial navigation, it will be left almost entirely to British authors to discuss the development of the aero-engine, stability, control at low speeds, lubricants and fuels and other important technical matters. It is earnestly to be hoped that the disparity thus revealed will be made good by the discussions which will ensue upon the papers. From the point of view of civil aviation, the Congress is expected by those interested in its organisation to do considerable good. Whatever we ourselves may think of commercial flight, we recognise the strength of the argument which has been advanced by Colonel O'Gorman that if the Congress succeeds in persuading foreign countries to raise the level of their commercial aircraft regulations and requirements to the high standard prescribed by our Government, it will be to the advantage of the British services, in that it will help to remove the natural tendency of the public to condemn all because of the conspicuous failure of some. It is notorious in this connection that the French standard of requirements is below ours, and that the repeated disasters which have overtaken French machines recently have very adversely affected the services run by British companies, in spite of the fact that our machines have been operated for more than a year without loss of life. As for the other civil and international aspects of the Congress, a study of the programme of papers reveals the fact that they will be concerned with such subjects as criticisms of the International Air Convention, the marking of aircraft, the international standardisation of model experimental apparatus, air mails, aviation insurance, and the design of commercial aeroplanes and airships. In none of these matters does it appear to us that any immediately important practical issue is involved, while in one only—the standardisation and comparison of experimental equipment and results—is there any real need at the present moment for international debate and action.

It would appear, then, that the Congress, from the point of view of this country, is not likely to yield any important benefit of a direct nature which could not be acquired equally well in other ways. Yet it is to be commended, and for our part we will support it, because of the indirect advantage which the fact of its being held in Great Britain will confer on our aircraft industry. During the war our aerial position was approached by no other country, allied or enemy, although for purposes of policy, so it has been stated, no claim to supremacy was ever made officially. We excelled, not only in the quality of our pilots, the numbers of our machines, and our capacity for production, but also in our ability to lead the world in the development of new ideas. To-day, it is commonly believed, we have sunk to the position of a third-rate aerial Power. It is true that many of our aircraft factories are closed and their skilled staffs dispersed and that those which remain in activity are finding it difficult to continue the struggle for existence. It is true that our aerial force has shrunk to minute dimensions as compared with its war-time state, and that British civil aviation is still showing no signs of reaching a prosperity sufficient to compensate even partially for the diminution of the military side. One thing, however, we have not lost. We still retain un-

impaired—indeed, perhaps enhanced by adversity—our ability to lead other nations in the field of aeronautical research and design. Opportunity to take full advantage of that ability may for the time being be wanting, but that the mental and physical equipment required to make British scientific workers and designers the leaders of their kind in the aeronautical world, exist to-day among us is patent and must be made obvious to the rest of the world. To that end the Congress provides a very direct road. Foreign opinion regarding British aeronautics is not what it ought to be, and there can be no doubt that if it were properly educated, as we trust it will be during the Congress, both by the papers to be read by British authors and by the visits to be paid to the principal aeronautical research establishments and aircraft factories, great encouragement and practical benefit would accrue to our position as an aerial Power. Because we see in the Congress an excellent opportunity for enlightening the rest of the world as to the strength and potentiality still resident in the foundations of our unchallenged wartime aerial supremacy, we welcome it and will do our part in promoting its success.

State Coal Mines.

IT appears to be certain that sooner or later we shall have another agitation for mines nationalisation. Indeed there is a Mines Nationalisation Bill before Parliament now. It is worth special attention, for it enables us to gather what is meant by nationalisation, and it gives us true indication of the intentions of the Miners' Federation. It provides for compensation and says, in effect, "we will pension off all the coalowners and royalty owners, relieve them of managerial and financial responsibility, and not suffer them to invest in development work; and we will tax the nation to value the mines and minerals, to nationalise the mines and minerals, to compensate the dispossessed owners, and for all administrative and development work." Furthermore, this Bill lays it down very distinctly that, whilst the nation is to pay the piper, the miners are to call the tune. The State is to pay, but the miners are to control. The miners are not even to be required to submit to arbitration if they object.

Taking the question of cost, what do we find? There is to be a valuation of every separate property; at what cost may be imagined. Then the colliery owners are to be bought out on the basis of from 10s. to 12s. per ton on the average annual output over the last five years. This means an expenditure of £121,000,000 or thereabouts, which is less than the amount actually invested. It is, let us admit, good compensation, relatively to the current dividends, which are meagre. The owners are to receive State mines stock and are to draw interest on this stock. The State is to pay for valuations, it is to pay interest on the stock, it is to pay a new army of officials to administer the mines and the coal trade, it is to pay for all future development work, and it is to stand the expenses of a vast network of "democratic" committees and all the madcap experiments the windbags care to try. Under this scheme, with its Mines Department and all its pit, area, district, and national committees and authorities, there will be, we are convinced, some fifty thousand officials and committeemen to pay. Then there is the question of minerals as apart from the collieries. The framers of this Bill, whilst definitely stipulating the amount per ton to be paid for the mines, and although they entitle the Bill one to nationalise minerals as well as mines, do not seem to have allowed for mineral royalties, as they are called. Here is a remarkable point. Under the existing system the State gets half the royalties and pays no estate administration costs. Out of the £8,000,000 a year the royalty owners receive annually for the mineral extracted, for the ground occupied by pit-head plants and sidings and cottages, for surface damages done by the mining operations, and for wayleaves over land not actually included in the leases, £4,000,000 at least are handed over in rates and taxes for the common good. There remain for the royalty owners hardly £4,000,000 a year for the depreciation of their estates, for the loss of agricultural rents, for the land occupied and damaged by the colliery workings, and for legal and estate expenses. The net yield is hardly 3d. per ton of coal. If we nationalise minerals, or what are called "royalties," at only twenty-five years' purchase, allowing not a penny in respect of the minerals left unmined at the end of twenty-five years, the capital cost will be £100,000,000, plus costs of valuations, plus costs of administration, plus the £121,000,000 capital cost of nationalising the collieries. The State will have to pay interest on the State minerals stock as on the State mines stock. With such finance a big loss to the State is inevitable and beyond question. Now let us turn to the administrative or operative side of the scheme. The State, which is to provide money for all the above-named expenses, is given no sort or kind of effective voice in the management. There is not a clause, provision, or line or word in this Bill to safeguard the public interest. There is to be a Ministry or Department of Mines. There is to be a Mining Council, half the members of which are to be Miners' Federation officials. But this Council, so constituted, is to have no power to do anything except in consultation with, and by the consent of, the Miners' Federation. Even if the miners do not get all their own way under this preposterous scheme there is to be arbitration between them and the State; but it is explicitly laid down that, in case the arbitration award is not favourable to the miners, they may reject it. No award is to be binding on the men. The nation is to pay all the costs, but the miners are to have unlimited and undisputed control and freedom of action. Let it be remarked in passing that when the Sankey scheme was before the country, based as it was upon one-sided evidence, the miners demonstrated that, whilst they were prepared to take they were not ready to give. Mr. Justice Sankey, in recommending nationalisation as a fit subject for "consideration," laid it down, among other things, that if the mines were nationalised the miners should sign contracts not to strike against the State unless and until their grievances had been considered by the various committees and councils, but the miners rejected the proposal.

If all these facts are not sufficient to damn the Bill, let us see how mines nationalisation has worked abroad. There have been two outstanding examples. Russia and Germany have tried State mines and both have failed. Germany had State mines many years before the war. But those mines never came up to the standards set by the capitalist mines in the same country. Their output was not so good, their costs were not so low, their wages were not better, their profits were not so high, their accident rate was not lower, and they did not sell coal cheaper than the capitalist colliery companies. The State, as mineowner, was constrained to come into the capitalist Coal Syndicate to present a respectable situation on the financial side, whilst the industrial side was such that Mr. Smillie, of the Scottish Miners' Federation, and Mr. Onions, of the South Wales Federation, condemned those German State mines after a special investigation. Following the war the Germans set up "democratic control." They formed committees of managers, miners, and consumers to run the pits. The results have been so unsatisfactory that the Government have just brought in a Bill to denationalise the mines. The confession of failure is now complete. In Russia they nationalised the mines without compensation, without taxing the community for valuations, for interest on mines' stocks or provision of sinking funds, and they tried democratic control. They have also tried bureaucratic or autocratic control. They have failed miserably. Output has fallen by at least 75 per cent; costs have gone to fearful heights; householders and industries have been short of fuel; and now the *Pravda*, a journal only permitted to print what is approved by the Socialist dictators, tells us that "the technical gear of the mines has so disintegrated" and that the "work and general organisation of the mines are so unsatisfactory that it has been decided to place the management on a new basis." The truth is that capitalists are being invited to return and save the situation.

Literature.

Alfred Yarrow: His Life and Work. Compiled by ELEANOR C. BARNES (Lady Yarrow). London: Edward Arnold and Co. 1923. Price 10s. 6d. net.

ANYONE who attempts to write the life of a person still living is faced with a serious and embarrassing difficulty. A certain reticence is imperative. It is clearly impossible to dissect a man's character before his eyes, and delicacy requires that many illuminating traits shall be passed over in silence. Miss Barnes, as she was when the greater part of this book before us was written, has suffered, as she was bound to suffer from this inevitable obstacle in the way of the production of a perfect biography. The reader feels constantly that the restraining hand of Sir Alfred was on her pen; that he would not let her say all that she wanted to say; that he would not allow her to present the complete portrait of himself; that he would not allow her to express openly the admiration that his character inspired. Probably Sir Alfred Yarrow is known to more people than any other engineer in England. His sympathies and interests are extremely broad, and he numbers his friends not only amongst those who can talk shop with him but, unlike many engineers, amongst those of a much greater circle and more diverse vocations. His business has brought him into intimate contact with high dignitaries, emperors and kings, but he has remained a simple gentleman, preferring the ease of his cottage to the dignities of his mansion, and shrinking from the publicity, the position and power which others with his success would have sought. Hence we can readily understand the difficulty in which his biographer found herself, and can the more heartily congratulate her on the success she has achieved.

Of the later years of Sir Alfred's life, of the great works he has carried out in them, of his war services, of his generous benefactions, and of the Convalescent Home, which is the apple of his eye, we propose at this time to say relatively little. Lady Yarrow has "compiled" all the facts for us, and were they abstracted from their context they would appear no more than as a bald catalogue of deeds in the short space we can devote to them. Moreover, many of them are but the history of yesterday, and are familiar to all engineers. It is rather of Sir Alfred's younger days, the days of struggle, the days of formation of character, that we propose to say something, for we believe that until they were laid open before the public by Lady Yarrow, few outside his circle of intimate friends knew much of them.

There is no one, contemplating a successful life, who does not desire to know how it began. What were the man's parents? What chances had he? Did he inherit brains or fortune? Did he enter the world to find a nitch already prepared to receive him, or had he to carve out his own fortunes? It is such human questions as these that first rise to the lips, and we propose here, briefly, with his biographer's help, to answer a few of them in respect of Sir Alfred Yarrow.

He was born in 1842, the son of a Christian father and Jewish mother. He had a brother who died in childhood, and he was, therefore, the only child of parents who were already approaching middle age when he was born. His father appears to have been an amiable, credulous, and warm-hearted man, who was so easily imposed upon that the little family was constantly in financial difficulties. From this father Yarrow may have inherited the warmth of heart, the ready kindliness of disposition which we all know so well, but it was undoubtedly from his mother that he received his energy, his quickness of intelligence, and his shrewdness, no less than the business ability which he has displayed throughout his life, and from her, too, he derived both by birth and by intimate daily encouragement that perseverance which defied obstacles and which in the end brought him to that success the attainment of which she never doubted.

After leaving a preparatory school, he was sent to a boarding-school at Reigate, "where he did not learn much," and at thirteen he went to University College School. Two and a half years later he was apprenticed to Ravenhill's, with whom he spent five years going through the ordinary course for gentlemen apprentices. During these years he heard as many scientific lectures as he could, and with his friends Hilditch and Rutt, he took an important part in the foundation of the Civil and Mechanical Engineers' Society, which held its first meeting in May, 1859, and was subsequently absorbed by the Society of Engineers. At the age of twenty-one his apprenticeship ceased, and he found himself a fully trained engineer but without prospects, without capital, and with a father who had just ruined himself by foolish speculation. At this bad juncture help came quite unexpectedly, and young Yarrow was presented by an aunt and a benefactor whom he had never met with £400 and with the offer of a £1000 should he require it from another source. This, if we may call it so, was Yarrow's one stroke of luck. That he would have succeeded without it no one can doubt who has followed his subsequent history, but at the same time we cannot deny that it was of material help to him at that time, as it enabled him to proceed with the development of a steam plough which he and Hilditch had invented. The plough was taken up by Coleman's, who allowed him £100 a year for managing their London office, and paid him royalties on the invention.

The plough brought in a little money, but two years later, when Yarrow was three and twenty or so, we find him getting restive and anxious to have a works of his own.

Here we come to the real starting point of his career, for to all of us who have known him long he will remain to the end Yarrow of Poplar, of the Isle of Dogs. It was with the acquisition of a small and miserable engineering works—a couple of old cottages and a few tumble-down sheds, with a handful of disreputable tools—that after a couple of years of weary struggling his success began. The whole story as we see it now is astounding; something

that can never be repeated. We have a young engineer, little more than a lad with a capital of about £1000, allied with a man, Hedley, older than himself, without money and with little energy and less buoyancy, starting boldly to become a manager of men, responsible, in some measure, for their welfare, conscious that they looked to him for their daily bread, and that almost wholly upon his shoulders rested the task of finding employment that would bring wages to them and meagre support to himself. Such things were possible in '65; they are not possible now, and we have grown so unaccustomed to them that they seem marvellous to us. The first two years of the partnership of Yarrow and Hedley at the Folly Wall, Poplar, was well-nigh disastrous. Yarrow toiled all day seeking orders and worked till late at night in the lonely cottage at the works completing drawings or making estimates. But nothing went well, and it was only his mother's ever-ready encouragement and her unfailing belief in his ultimate success that sustained him. A few jobs fell to the firm, but they were carried out at a loss, and at the end of two years' hard work Yarrow and Hedley were £2000 in debt. His biographer is a little more sparing of dates than we could wish, but we gather that at this time Yarrow was about five and twenty. Certainly it was in the spring of 1868 that fortune changed.

At that time Yarrow, driven to his wit's end to find work, bethought him how, when they were 'prentices together, he and Hilditch had built a notable little steam launch—the Isis. Could he follow up that success and make a business of it? He would try. It was the "last resource. Without capital, and with the business considerably in debt, but with increased experience," Yarrow advertised that "Anyone wanting a steam launch would be well served" by Yarrow and Hedley, and "awaited developments." The waiting was brief, as if the Fates, having passed their novice through his years of trial, were in haste to bring him the reward he had earned. After three days, "an old gentleman, Colonel Halpin," ordered a 24ft. steam launch. It was completed in two months, and handed over to its owner for the contract price of £145—but it cost the firm £200 to build! That bad beginning was retrieved by Yarrow. At the end of the summer he bought back the launch for £100 and sold it the same day for twice that sum, and in the following year he again bought it for £100 and sold it once more, and finally, for £300 to a Russian nobleman. The success of that little vessel made the success of Yarrow. Orders for steam launches came in plenty, and by 1875 no less than 350 had been built. Amongst them, possibly the most famous, was the Ilala, which was sent out in sections to Lake Nyassa and reconstructed there.

By 1875, then, we find Yarrow firmly established as a launch builder with a fine reputation and a healthy business at the Isle of Dogs. He was still only in his thirty-third year, and in less than seven years he had brought his little firm from the edge of bankruptcy to unexpected affluence. Thence onwards his progress was constant. He seized the opportunity which was offered by the need of small fast vessels for carrying spar torpedoes, and step by step passed from them to the building of torpedo boats and thence to the construction of destroyers. In three chapters, Nos. VIII., IX., and X., Lady Yarrow sketches for us the notable boats that were built between the years 1875 and 1912, and gives us admirable illustrations of several of them—such vessels as the Havock and Hornet, the Sokol and the Lurcher, most famous of all. In another chapter, No. XVII., we find short histories of several more of the interesting vessels turned out by the firm, and in still later chapters records of the war services of Yarrow-built boats are given. But these things are not Yarrow, and it is in Yarrow himself that we are interested.

So here we may leave a volume which we have read with much pleasure—one that is not only a biography, but a history of a very eventful period in the development of our own and foreign navies. Lady Yarrow has done her work admirably, and we can assure any of our readers who may have doubts about the technical parts of her story that they will bear the closest scrutiny. The future may require that another "Life" shall be written of Sir Alfred Yarrow, but the present work will remain unchallenged as a source of accurate information, and it is not likely to be excelled in lucidity and simplicity of style.

Farm Implements and Machinery. By J. R. BOND, M.Sc. London: Benn Brothers, Limited. 35s. net.

FARMERS, as a rule, are not readers of technical literature, otherwise there would be more publications of a kind similar to that before us. Until the advent of the motor car their knowledge of mechanical appliances was almost exclusively confined to the few implements which they employed. In this respect there has been material improvement in recent years, for there are few farms of any size now that do not employ some form of motive mechanism for operating their plant. This book is not offered as a complete treatise on farm engineering, and it has not been written specifically to meet the requirements of students reading for examinations; its purpose, according to the preface, is to assist the progressive farmer who wishes to understand the work and workings of farm implements and machines, to enable him to select those most likely to be useful to him, and to adjust, operate and take care of them. In this respect the book deserves to be well received, for there is no class of machinery that is generally more ill-used or neglected than agricultural implements. One of the reasons for the apparent neglect of agricultural implements by the farmer is that they are in use for only a very short period of the year, when, having done their work, they are left to rust in the fields or, at best, in open sheds, exposed to the weather.

The volume is divided into twenty-one chapters, opening with the subject of tillage, which the author describes as the mechanical operations to which the soil is subjected in the regular course of crop production, ploughing being the basic tillage operation. With ploughs and their functions the author deals very fully in the succeeding chapters, and the uninitiated reader will be surprised to find how many different kinds of plough there are. In the chapter on setting and operating the plough, interesting information respecting the power required to plough land of different kinds is given, and this chapter should be read in conjunction with chapters seventeen and eighteen, which deal with tractor tillage. On the latter subject Mr. Bond's remarks are not very encouraging to the agricultutal tractor makers. Referring to the great development in tractor cultivation which was brought about by the war, he recognises the great assistance to the farmer which mechanical traction rendered, but says that since 1921 the conditions regarding labour and the price of horses have so changed that the advantages of the tractor over the horse team in the matter of cost have become less apparent. Nevertheless, it cannot be denied that the tractor, with its greater speed, its greater working width, and its ability to continue at work almost indefinitely enables the farmer to carry out his operations at the right time and keep up with his seasonal work. A man operating a tractor and self-lifting plough can perform from one and a-half to three times as much work per day as he could if driving a horse team. Figures relative to the comparative costs of animal and mechanical tillage operations have been published from time to time, and the *pros* and *cons* of the subject are dealt with very fully. Tractor makers can make out a very good case for mechanical haulage, and there are few arable farms on which a reliable tractor cannot be employed to advantage, but unreliable machines or machines badly handled may prove very unprofitable.

The chapter on mechanical cultivation deals in a very lucid manner with cable haulage. The advantages of that system are that the engines do not compress the soil or subsoil, work can be carried on on stubbles that are too hard or too soft for the tractor, and deeper work is possible. The chief drawbacks are the obvious greater outlay of capital and the necessity for more labour, even though the output per man may be higher. There are four methods of working cable tackle:—(1) The double engine system; (2) the single engine system; (3) the windlass tractor system; and (4) the windlass plough. The first named is the favourite method on large farms and is chiefly operated by firms which undertake the operations on the per acre basis.

The chapter on heat engines deals with steam and internal combustion engines of the several types which are best known by agriculturists. The author describes the functions and principal features of these engines in a manner which is capable of being understood by those for whom the book is written.

SHORT NOTICES.

Atoms. By Jean Perrin. Translated by D. Ll. Hammick. London: Constable and Co., Limited. Price 8s. 6d. net.—This second and revised English edition of the work entitled "Les Atomes," by M. Perrin, Professor of Physical Chemistry at the Sorbonne, Paris, provides a most interesting, suggestive and authoritative account of modern molecular and atomic theory and physics. The subject is one lending itself, to a considerable extent, to mathematical treatment, but it will be found that in this book the author, except in a few places, relies entirely on the written word, and resorts sparingly to mathematical argument. The book, in fact, is quite suitable for the general reader possessing some scientific knowledge, but it should not be mistaken for one of the so-called "popular" variety. Molecular physics exercises great fascination for many. It combines, to a satisfying and refreshing extent, a pure speculativeness on matters of the most fundamental and far-reaching kind, with a constant appeal, for confirmation, guidance and suggestion, to direct practical experiment. Professor Perrin has handled his subject inspiringly, yet with well-restrained enthusiasm. The clarity and simplicity with which he expresses himself has been ably preserved by Mr. Hammick, his translator.

The Destructive Distillation of Wood. By H. M. Bunbury. London: Benn Brothers, Limited. Price 35s. net.—Although the destructive distillation of wood has been practised for several generations in America and Europe, Mr. Bunbury is still in the fortunate and enviable position of being able to say that until now there has been no book in English dealing with this subject exclusively. That omission he has made good in a most commendable manner. In its chemical and mechanical, theoretical and practical aspects, his book should command the respect of all interested in or connected with the rapidly advancing and highly important industry—or, more correctly, chain of industries—dependent upon the destructive distillation of wood and the products derived from that process. The thermal decomposition of wood yields charcoal, acetic acid, alcohol, acetone, wood tar oils, turpentine and gas, while from the tar itself are obtained, by distillation, various important substances, such as pitch, wood creosote and several varieties of oils. Mr. Bunbury treats all these subjects primarily as a chemist—he is Research Chemist to the British Dyestuffs Corporation—but does not forget to deal adequately with the practical and equally important mechanical side of his subject. The book is remarkable for the large amount of numerical data which it contains.

The Manufacture of Cane Sugar. By L. Jones and F. L. Scard. Published under the auspices of the West India Committee, by Duckworth and Co., London. Price 25s. net.—Since the first edition of this important book was published in 1909, there have been many developments in the manufacture of cane sugar, and in meeting the demand for a second edition of their book Messrs. Jones and Scard have taken the opportunity to revise it and bring it up to date. In 1901, the production of beet sugar exceeded that of cane sugar, but by 1909 the position had become reversed, and since then cane sugar, its position greatly strengthened by circumstances arising out of the war, has maintained a handsome lead. Clear signs are now, however, evident that the continental beet industry is rapidly recovering, and that at no distant date, apart from any developments taking place in this country—and they are apparently no longer to be regarded as negligible—beet sugar may once again prove a troublesome rival to cane sugar. The public will no doubt appreciate and probably benefit from the situation, but to proprietors and managers of cane sugar estates and to those supplying them with plant and machinery, it will mean renewed efforts to maintain the present supremacy. Messrs. Jones' and Scard's book should provide them with great assistance to that end.

Belt Conveyors and Belt Elevators. By F. V. Hetzel. New York: John Wiley and Sons. London: Chapman and Hall, Limited. Price 25s. net.—Although this is an American book by an American author, there is much in it, if we mistake not, that will be found of great practical value by British engineers interested in conveying devices, and by rubber and other manufacturers supplying conveyor and elevator belts. The book, the author says, is intended to be practical, and is the result of thirty years' experience of conveying and elevating materials by belt and bucket. We have examined it carefully, and are of opinion that it fully merits the author's claim for it that it is no mere restatement of manufacturers' catalogue material, but is primarily concerned with principles and reasons. It is sufficiently descriptive and sufficiently well provided with illustrations and data to prove a valuable aid and guide to draughtsmen and designers. At the same time it reviews and criticises very freely and independently established practice, and discusses the theory of its subjects in a simple but satisfying manner.

BOOKS RECEIVED.

Carrateristiche Costruttive delle Turbine Idrauliche negl'impianti Attuali. Milan: Antonio Vallardi.

Modern Gas Producers. By N. E. Rambush. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 55s. net.

Absorption of Nitrous Gases. By H. W. Webb. London: Edward Arnold and Co., 41–43, Maddox-street, W. 1. Price 25s. net.

The Deflections of Suspension Bridges. By John W. Spiller. London: The Institution of Civil Engineers' Great George-street, S.W. 1.

Ministry of Public Works, Egypt, Physical Department, Meteorological Report for the Year 1918. Cairo: The Government Press. 1923.

The Causes and Prevention of Corrosion. By Alan A. Pollitt. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 25s. net.

Radiotélégraphie, Radiotéléphonie, Radioconcert. By E. Reynaud-Bonin. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 10f.

Electric Lift Equipment for Modern Buildings. By Ronald Grierson. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 15s. net.

L'Electrodynamique des Milieux Isotropes en Repos, d'après Helmholtz et Duhem. By Louis Roy. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins.

The Providence Zone Plan: Report Outlining a Tentative Zone Plan for Providence. By Robert Whitten. City of Providence Joint Standing Committee on Ordinances. 1923.

The Electrical Handling of Materials. Vol. IV., *Machinery and Methods.* By H. H. Broughton. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 50s. net.

Jane's All the World's Aircraft, 1923. Edited by C. G. Grey, Editor of the *Aeroplane.* London: Sampson Low, Marston and Co., Limited, 100, Southwark-street, S.E. 1. Price £2 2s. net.

The Railways of Spain. By George L. Boag, general manager, Great Southern of Spain Railways. London: *The Railway Gazette and Railway News,* 33, Tothill-street, S.W. 1. Price 12s. net.

Railroad Electrification and the Electric Locomotive. By Arthur J. Manson. New York: Simmons-Boardman Publishing Company, 30, Church-street. London: 34, Victoria-street, S.W. 1.

Oilmen's Sundries and How to Make Them: A Collection of Practical Recipes. Compiled by "Technicus." London: Scott, Greenwood and Sons, 8, Broadway, Ludgate, E.C. 4. Price 5s. net.

Workshop Routine, its Principles and Application, with Special References to "Standing Instructions." By W. J. Hiscox. London: Chapman and Hall, 11, Henrietta-street, W.C. 2. Price 9s. 6d. net.

A Cold-starting Oil Engine.

THE oil engine shown in the engraving below is one of a new series which has just been brought out by Petters, Limited, of Yeovil. It is of the two-stroke, sold-injection type, and is made in several sizes ranging in output from 5 up to 36 brake horse-power. The smaller sets have single cylinders.

The engine represented by our illustrations is the 36 horse-power model, and runs at 450 revolutions per minute, but it is capable of carrying a maximum load of 46 brake horse-power. The cylinders are 8in. in diameter by 9in. stroke, and work at a mean effective pressure of 44.5 lb. per square inch for the maximum load. The compression pressure is 180 lb. per square inch.

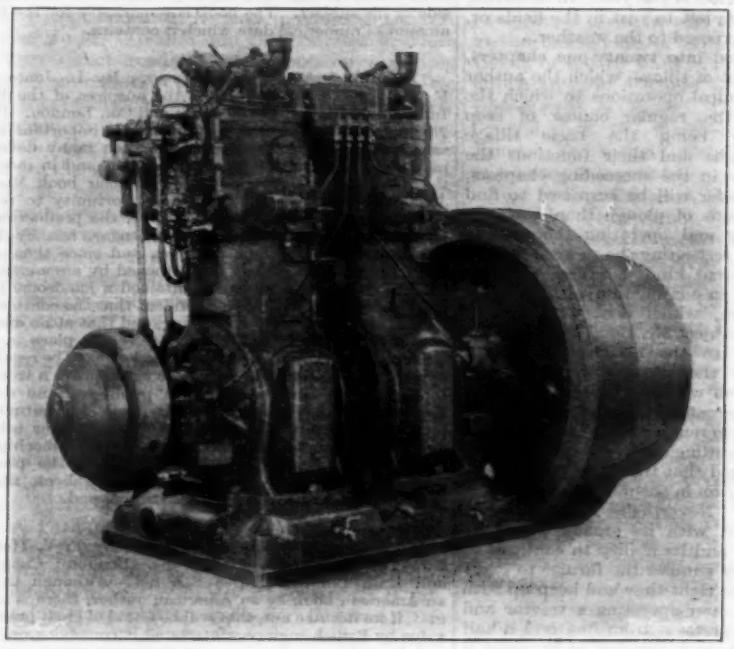


FIG. 1—PETTER 36-H.P. SOLID-INJECTION OIL ENGINE

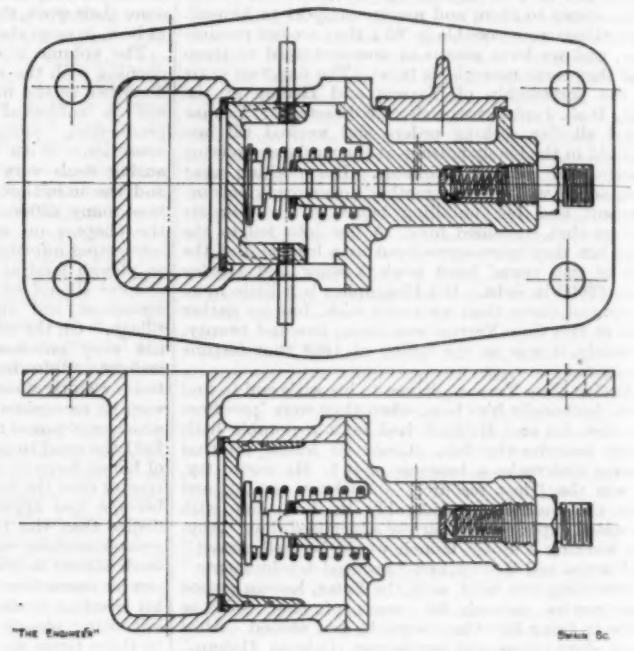


FIG. 2—PISTON-LUBRICATING PUMP

As will be seen from the line drawing—Fig. 3—the cylinder and crank case are made as one casting, while large openings are arranged in the sides of the casings, so that the crank shaft may be threadled into place. The openings are closed by cover plates, which have spigots to ensure correct alignment, and carry the main bearings. It will be noticed that the bearings are all entirely outside the cover plates, so that when their keeps are removed, the brasses can be taken out by twisting them round the journals.

The main bearings have oil wells that are fed from a reservoir, which can be seen in Fig. 1, between the two cylinder heads, through sight feeds. The oil is picked up from these wells by rings and fed to the journals in the normal manner. In the case of the two outside bearings, the rings are at the outside ends, and the oil is carried along the journal by a spiral groove cut on the shaft. At the inside end this groove terminates at a hole that is drilled through the crank web to the crank pin. The rotation of the shaft screws the oil along the spiral groove and forces it through the hole to the crank pin bearing. The oil escapes from the big end into the crank chamber, and is splashed up to lubricate the gudgeon pin. Any oil which may be forced outwards along the main bearings by the compression pressure in the crank case is trapped and drained back to the oil well.

For lubricating the piston, a small pump is mounted on the front of each cylinder. This pump, which is shown in detail in Fig. 2, is operated by the variation of the air pressure in the crank case. It has a comparatively large piston, working in a barrel that is in communication with the crank case, and a smaller plunger for forcing the oil forward. The areas of the piston and plunger are in the ratio of 15 to 1, and as the compression pressure is about 4 lb. per square inch, the oil is delivered at a pressure of some 60 lb. per square inch. The oil is supplied to the pump by a sight feed, and is delivered to four points round the cylinder walls.

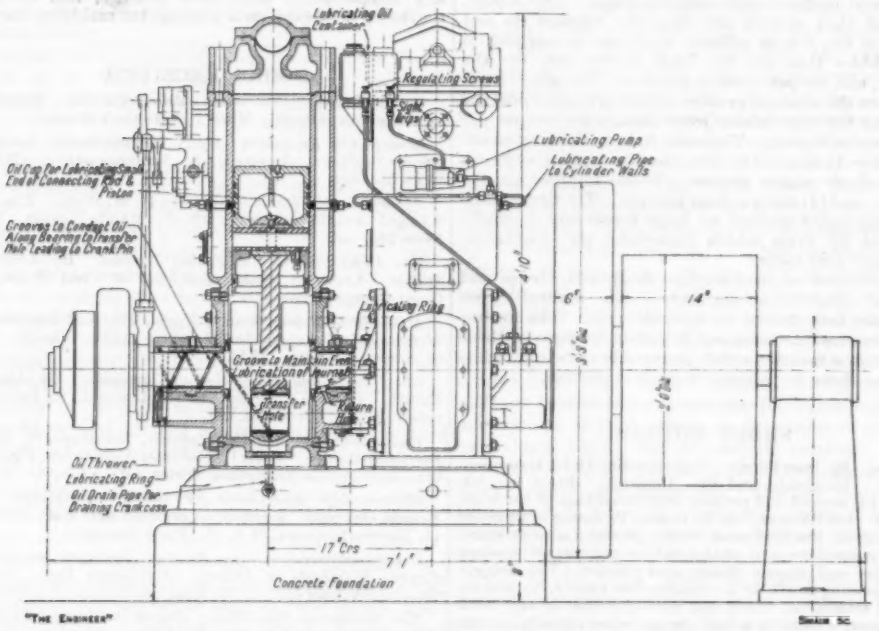


FIG. 3—ARRANGEMENT OF PETTER SOLID-INJECTION OIL ENGINE

A noteworthy feature about the engine is the provision of a device for starting it expeditiously from cold. This device, which we illustrate in Fig. 4, takes the form of a small container which is screwed into the vaporiser in such a position that the fuel spray impinges upon it. On starting up the engine, a cartridge of impregnated tinder is slipped into the container and is lit with a match. The heat generated by the combustion of the tinder is sufficient to explode the first charge in the engine, and will keep the end of the container sufficiently hot to maintain the explosions until the engine has got under way, and the hot bulb has warmed up.

The makers say that these engines will run indefinitely on no load without any secondary injection to keep the bulb hot, and claim a fuel consumption of half a pint of oil per brake horse-power per hour.

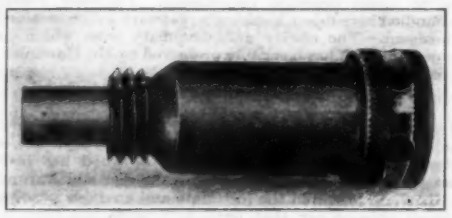


FIG. 4—COLD-STARTING DEVICE

THE INSTITUTION OF GAS ENGINEERS.

THE annual general meeting of the Institution of Gas Engineers will be held in Belfast on Tuesday, Wednesday and Thursday, June 26th–28th inclusive. On the Tuesday at 10.30 a.m. members will assemble in the City Hall, where they will be welcomed by the Lord Mayor of Belfast, and after hearing the address of the President—Mr. James D. Smith, M. Inst. C.E., the engineer and manager of the Belfast Corporation Gasworks—will consider and discuss the eighth and ninth reports of the Gas Investigation Committee, which deal with :—"The 'Fairweather' Recording Calorimeter" and "Aeration in Atmospheric Burners" respectively. In the evening at 7.30 p.m. the Lord Mayor and Lady Mayoress will hold a reception in the City Hall.

On the Wednesday at 10.30 a.m., after a meeting of the Benevolent Fund, the following will be read and discussed : —Paper on "The Flow of Gas in Pipes," by Mr. Stephen Lacey ; the tenth report of the Gas Investigation Committee dealing with "Further Examination of the Blue and Carburetted Water Gas Processes" ; and a report of the Institution of Gas Fellowship entitled "The Gasification of Coke in Steam, with special reference to Nitrogen and Sulphur," by Messrs. Stuart Pexton and J. W. Cobb. In the afternoon, after luncheon at the City Hall at the invitation of the Corporation Gas Committee, a visit of inspection will be paid to the Belfast Gasworks. In the evening at eight o'clock a lecture on "The Flow of Gas" will be delivered by Professor W. B. Morton in the Physics Lecture Theatre of Queen's University.

On the Thursday morning at 10.30 a.m. a paper on "Distribution in Belfast," by Mr. A. M'I. Cleland, and a paper on "Ammonia Yields from Vertical Retorts," by Mr. George Braidwood, will be read and discussed ; and a report of the Refractory Materials Committee introduced by Mr. A. E. Broadberry, the chairman of the committee, and dealing with (*a*) "Refractoriness under Load" ; (*b*) Fortifying Refractories with Sillimanite" ; (*c*) "Carbonised Clays" ; and (*d*) "Is the Purification of Fire-clays worth While ?" ; and the report of the Life of Gas Meters Committee will be discussed. In the afternoon a visit will be paid to Bellevue-gardens, Glengormley.

For Friday, the 29th inst., a visit to the Giant's Causeway has been arranged.

THE Basingstoke and Alton Railway is not to be abandoned after all, but is to be restored and worked for another ten years. This statement was made by Viscount Younger, a director of the Southern Railway, when that company's Bill came up for third reading on the 5th inst. The main reason for this change of front was evidently found in the fact that when the London and South-Western promoted the Bill for the construction of the line, a rival scheme was in the field, and the company secured its withdrawal. It is said that the line does not pay. Possibly the traffic to and from the stations on the line may be worked at a loss, but when a map of the district is studied it will be seen that passengers for Basingstoke and the north and west thereof from the Alton district have either to travel *vid* Woking or Winchester, and this factor should be taken into consideration. A through service between Guildford and Basingstoke *vid* Alton might be a great public convenience.

The Flettner Rudder on the Motor Ship Odenwald.

IN our Journal of July 14th last we made reference to the Flettner rudder and briefly indicated the success which had attended the experimental application of this new form of steering device. About a month after our notice had appeared, considerable interest was aroused in European shipbuilding circles by an article published in the German technical journal *Werft-Reederei-Hafen*,* in which the inventor described the evolution of his idea, its first application for aeronautical purposes, and its later marine development. In particular an illustrated description was given of the experimental rudder, which was made and fitted to the small 200-ton ocean-going cargo steamer the Frigido, of the Batavier Line. This vessel has performed satisfactory service over two and a-half years, and has furnished results which warranted the building of a further rudder for a vessel forty-five times as large. In the present article we describe the rudder which has been installed on the Hamburg-American liner Odenwald, built at the Deutscher Werft, Finkenwärder, Hamburg, a new twin-screw motor ship which is now on her maiden voyage to South America.

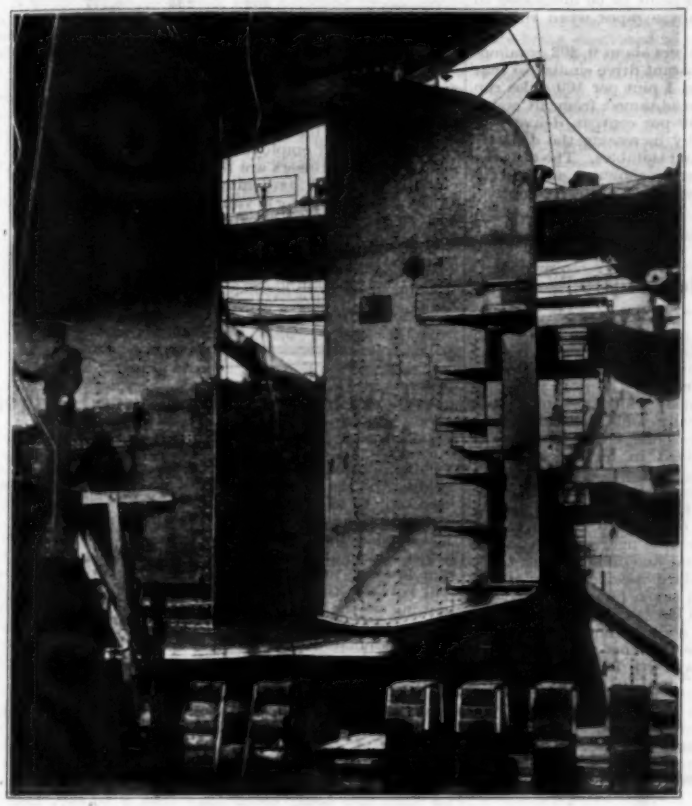
The general principle upon which the working of the rudder depends is illustrated by the drawing reproduced in Fig. 3.

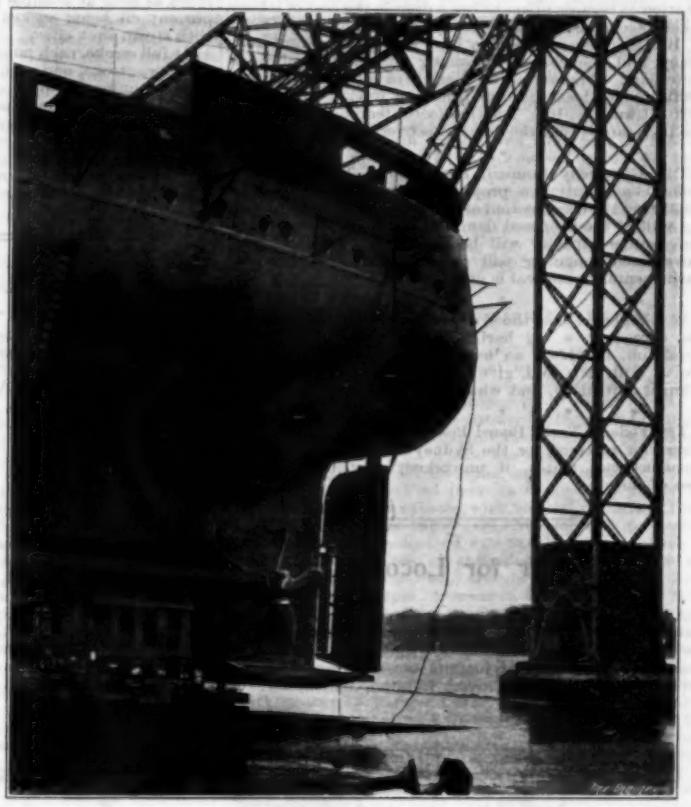
The object of the invention is to do away entirely with heavy and expensive steering gears and to replace them by a simple form of rudder worked by the stream line pressure exerted on the rudder by the water through which the vessel is moving. This end is accomplished by a small auxiliary rudder or deflector B, which is placed at the back of the main rudder plate A, and which by its movement turns the main rudder. The combined effect of the small deflector working at a long leverage and the power of the current of water acting on the whole system imparts to the main rudder a large turning movement enabling it to act with a prompt and energetic steering action. The general arrangement of the two rudders and the operating gear will be seen from the drawing. The motion of the small rudder is controlled by the pair of yokes C with horizontal interconnecting rods C^1, which are operated by the control shaft C^2 passing vertically through the hollow axis of the main rudder, which is connected to the gear-box F at the head of the main rudder post. Pivoted at its lower end on the support E and turning in upper bearings, the main rudder is independent of the turning gear for the small rudder and is quite free to take up any position. When the vessel is going astern it moves through 180 deg. into the position indicated by the dotted lines D, and then acts as a bow rudder. In this position the steering principle remains the same. The rudder system acts very promptly under the influence of the propeller suction, the main rudder turning under the influence of the astern running propellers even before the motion of the ship herself has begun to reverse. On the Frigido the small deflector was controlled by a steel wire rope passed round a drum fixed at the upper end of the vertical shaft and connected with the wheel on the bridge. The arrangement adopted on the Odenwald consists of the usual system of 1in. diameter steering gear shafting connecting the gear-box F with the Flettner steering wheel P on the poop, and further through the shaft K with the main steering wheel on the bridge. An electric winch W serves as an emergency steering gear, and may be connected to the spare tiller G by means of the intermediate shafting J. Figs. 1 and 2 show the actual rudder on the Odenwald. The main rudder has a total area of surface of about 140ft., while the deflector has a surface of about 12ft. Both the deflector and the large rudder, which are partly balanced, are fish-shaped in horizontal section. Fig. 2 shows the rudder in its astern position, this view being taken immediately before the launch of the ship from the company's yard at Finkenwärder, near Hamburg.

During the thirty hours' trial of the Odenwald, the Flettner rudder installation worked with satisfaction, the ship being steered only by the hands of the steersman. Experience showed, however, that the friction in the steering gear shafting and transmission wheels was unnecessarily large compared with the actual effort required to turn the deflector. This friction could be greatly reduced by fitting ball bearings to the steering gear shafting, which will probably be done later. The question of adopting a telemotor gear between the deflector and the bridge wheel has also received favourable consideration.

The Hamburg-American Line, the owners of the Odenwald, have combined the Flettner installation with another invention of not less importance, namely, the Anschütz self-steering gyroscopic compass. The well-known gyroscopic compass of Dr. Anschütz has been further developed by the inventor to act as a steersman. This result has been obtained by the following method:—At the circumference of the compass a series of electric contacts are provided at small intervals, opposite to which is a single contact which is fixed to the hull of the gyroscope. In the lower part of the compass housing there is a ¼ horse-power electric motor, which is coupled by a chain to the axis of the steering wheel. The motor is controlled by the system of contacts on the compass, and is propelled in either the one or other turning sense depending on the turning motion of the ship. The course is set by the officer on watch, after which the vessel is automatically steered and continually corrected by the gyroscope. It is claimed that the steering is more exact than that of the steersman, and the human element is moreover eliminated. The combination of the Flettner rudder with the steering compass certainly marks an interesting development in navigating machinery, and the further progress of this system will be watched with interest.

The Odenwald ran her trials in the Bight of Heligoland on the first and second of last month, and seven days later started on her maiden trip to South America. Built to the Germanischer Lloyd Classification 100 4 L special survey, she has the following particulars:—Length between perpendiculars, 398ft. 3in.; beam, 53ft. 11in.; moulded depth, 38ft. 3in. Her draught when loaded is about 26ft. 3in., and she has a deadweight capacity of 9000 tons all told, with a gross registered tonnage of about 5000 tons. The machinery comprises two 1250 indicated horse-power Diesel engines, which are designed to give the vessel, when loaded under service conditions, a speed of 12½ knots.





FIGS. 1 AND 2—THE MOTOR SHIP ODENWALD WITH FLETTNER RUDDER IN AHEAD AND ASTERN POSITIONS

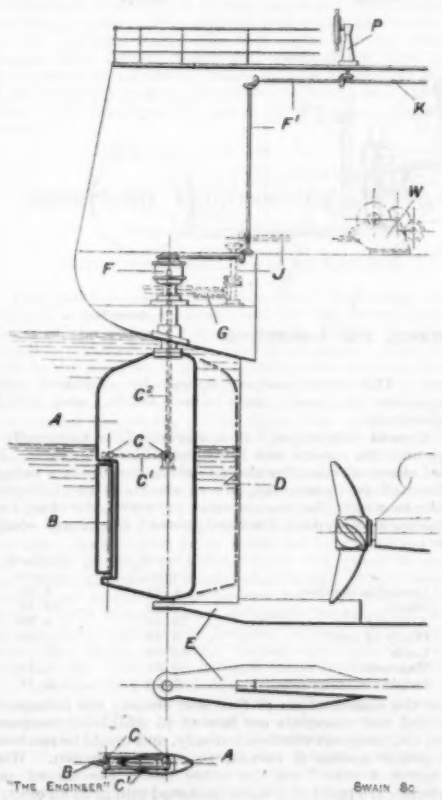


FIG. 3—DIAGRAM SHOWING WORKING OF FLETTNER RUDDER

* *Werft-Reederei-Hafen*, No. 16, August 22nd, 1922. "Das Strombetätigte Ruder," by Anton Flettner, of the Flettner Scheepstroer Maatschappy, Rotterdam.

Australian Engineering Notes.

AN idea of the traffic dealt with at the Sydney railway station may be formed from a statement made by the Chief Commissioner, that on the Thursday before Good Friday last, no fewer than 447 trains were despatched, while at some periods of the day a train left Sydney every minute.

* * * * * *

COMMENCED eleven years ago, the ambitious project planned by the Victorian Railway Commissioners for the electrification of the whole of Melbourne's suburban railway system has reached fruition. Based on Flinders-street Station, Melbourne, the electric service extends in all directions, and reaches its maximum length for any one line at Frankston, a bay-side resort 26 miles from the metropolis. Besides materially shortening transit times between Melbourne and the outer suburbs, the new service has resulted in a more expeditious handling of traffic at Flinders-street, which deals with upwards of 2000 trains daily. The Commissioners are now giving consideration to the question of electrifying the more important country lines. Though no official announcement has been made, it is known that the Department would most probably commence with the main line to Gippsland, taking it, perhaps, as far as Traralgon or Bairnsdale. An early pronouncement on the subject is being eagerly awaited in Victoria.

* * * * * *

ACCORDING to an announcement made by the Victorian Minister of Railways, the programme of railway construction to be undertaken in the State will provide for the completion of six additional lines. Of these three are in progress, and the following will be commenced shortly:—Annuello to Bumbang, 19¼ miles, £107,000; Kerang to

Gonn Crossing, 16 miles, £96,200; and Hopetoun to Patchewollock, 27½ miles, £125,000.

* * * * * *

THE records of the Metropolitan Board of Works, Melbourne, show that there are more houses now under construction in the suburban area than at any previous time in the history of Melbourne. This brisk activity in building continues, despite the fact that constructional costs are far in advance of the prices ruling in 1914, though slightly lower than those prevailing in the boom period of 1920. A leading Melbourne timber merchant has stated that there is no prospect of any amelioration of the present position as regards prices unless a drop in the cost of labour takes place. Quotations for imported timbers declined in 1921, but since then they have shown an upward tendency, and the cost of obtaining Australian timbers is increasing. Whereas in the years 1918–19 it cost 14s. per 100ft. to get local timbers from the forest, the cost in 1920–21 was 19s. 10d. Another factor tending to maintain the high rate is that the demand is overtaking the supply.

* * * * * *

THE Glenorchy Council, in Southern Tasmania, has under consideration a project for expending a sum of £60,000 on the construction of a new reservoir. The retaining wall of the proposed dam will be 80ft. in height, and the storage capacity will be 155,000,000 gallons. The Government engineer will report on the plans before parliamentary approval is granted.

* * * * * *

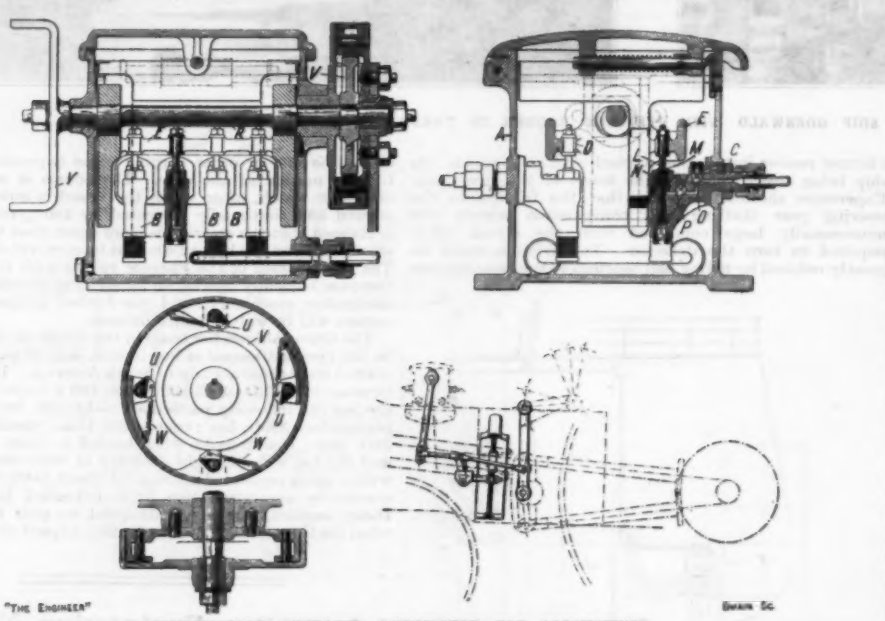
IT is reported that the Western Australian Government has agreed to a big harbour development scheme at Geraldton, involving an expenditure of £400,000. The project will, it is said, give Geraldton a good harbour, a channel 30ft. deep, and wharf accommodation.

* * * * * *

THE Federal Tariff Board has informed intending tenderers for material for the Sydney Harbour Bridge that constructional plates, if unworked, may be admitted free of duty.

Lubricator for Locomotives.

A SIMPLE and positive lubricator specially designed for locomotives is illustrated in the sectional drawings give herewith. It has been in use for some time on Midland engines, and is now being manufactured for general application by Gresham and Craven, Limited, Manchester. It



MECHANICALLY OPERATED LUBRICATOR FOR LOCOMOTIVES

is particularly intended for supplying lubricant to the steam cylinders of engines fitted with superheaters, where expensive oil is used, and it is therefore important to economise as far as is consistent with continuity and efficiency. For this purpose an extremely sensitive clutch is used to transmit movements to the oil pump plungers.

From the two upper views in the engraving, which show a sectional elevation and a cross section through the lubricator, it will be seen that the apparatus consists of a main reservoir A, into which are fitted pumps B. Each pump is quite independent, and is secured to the wall of the reservoir by a shank and nut C. Slots D in the driving frame E receive thimbles, fixed to the ends of the pump spindles, permitting any pump to be readily withdrawn from the reservoir by removing the nut C. The pumps, which are double-acting, comprise a plunger L of two diameters. The large end fits the pump cylinder, while the top end passes through a sleeve M seated loosely in the gland nut N, against which it is held by a leather washer. There are one suction and two delivery ball valves, and the arrangements are such that on the up stroke the oil above the enlarged portion of the plunger is delivered past the valve O, while on the return stroke the charge passes the valve P, half of it following the descending plunger, and the remainder being delivered past the valve O, thus maintaining a constant flow of lubricant through the outlet. The driving frame E, operating the pumps, is reciprocated by excentrics on the shaft R.

The driving clutch, which is seen in the upper and lower drawings on the left-hand side, consists of an inner and outer casing, which carry the pawls U. The latter bear on the smooth periphery of the wheel V, and are arranged in such a manner that when the outer casing—to which is attached the driving lever—is moved in one direction, the driving pawls carry the wheel forward, while on the return movement the backlash pawls, carried by the inner casing, hold the wheel. The pawls are held against the wheel by the springs W. The arrangement enables very small angular movements of the driving wheel to be obtained. A cylindrical strainer enclosing the suction valve is fitted to each pump, in addition to the main strainer, while a warming pipe for use in cold weather and a drain plug are provided in the bottom of the main casing. The handle Y allows of the pump being operated by hand for the initial charging of the pipes. A back pressure valve should be fitted as near as possible to the point to be lubricated to prevent oil being sucked from the pipes when running with steam shut off.

At full stroke, each pump delivers about 0.202 grammes of oil per stroke, and with a constant drive similar to that shown a uniform supply of from 1 pint per 100 miles run to any desired amount may be obtained from an eight-feed pump. Variation up to 30 per cent. in delivery of any pump may also be made by increasing the distance between the flanges on the driving thimbles. The drawing in the right-hand bottom corner shows a method of operating the lubricator from the motion of the locomotive.

"Ciment Electrique."

IN a paper which he read last evening before the Institution of Structural Engineers, Mr. D. B. Butler gave some interesting particulars regarding "Ciment Electrique," "Ciment Fondu," or "Alca Cement," as it is variously called. It was, he said, a cement which was of a type entirely different both chemically and physically from ordinary Portland cement. Its chief characteristic was its rapid hardening; it attained in forty-eight hours substantially the same strength that most Portland cements would develop in twenty-eight days. In spite of this attribute, however, its initial and its final setting times are not less than those of average British rotary kiln cement. In some comparative figures given in the paper it is shown that its initial and final setting times as ascertained by British Standard Specification methods were two and a-half hours and seven hours respectively. Comparable figures for a typical British rotary kiln cement are two and a-quarter hours and six and a-half hours respectively. Yet, whereas the breaking strength of the British neat cement at seven days was 793 lb., that of the sample of "Ciment Electrique" was 1033 lb. at the same time. The corresponding figures for standard sand briquettes at seven days were 402 lb. and 489 lb. respectively.

"Ciment Electrique," it is explained, is essentially a high-alumina cement and it is almost black in colour. Its chief chemical constituents, as determined from a sample submitted two years ago, are as shown in the following table, in which, for comparative purposes, the chief constituents of a typical Portland cement are placed alongside :—

	"Ciment Fondu."	Portland cement.
Insoluble residue	1.74	0.26
Silica	10.10	23.31
Alumina	39.46	6.38
Oxide of iron	5.35	3.10
Lime	42.55	63.27
Magnesia	0.57	1.16
Sulphuric anhydride	0.10	1.14

In the manufacture of Portland cement the intimately blended raw materials are heated to clinkering temperature, *i.e.*, incipient vitrification only, and would be rendered altogether useless if carried to complete fusion. With "Ciment Fondu," on the other hand, the mixed raw materials are fused in a water-jacketed kiln or in an electric furnace, the subsequent operation of grinding the calcined mass to a very fine powder being carried out in the same manner as with Portland cement. As a matter of fact, grinding appears to be carried considerably farther than is the case with, at any rate, the majority of British cements. The figures given by Mr. Butler for the residues on 180 × 180 and 76 × 76 sieves are 1.7 and 1.0 per cent. respectively. The maximum permissible residue with the 180 × 180 sieve is, it will be remembered, in the British Standard Specification 14, and though manufacturers in this country are, for the most part, accustomed ordinarily to grind their clinker to a considerably greater degree of fineness that that, they very rarely, in general practice, approach the figures given for the "Ciment Electrique."

Concerning the rapidity with which the "Ciment Electrique" hardens, Mr. Butler gives the following figures which are the results of tests on the material which he made some six months ago :—

	Tensile tests. lb. per sq. in.		Crushing tests. lb. per sq. in.	
	Neat.	3–1 sand.	Neat.	3–1 sand.
One day	602	253	6,777	2,814
Two days	833	373	7,741	4,414
Seven days	933	512	9,089	5,810
Twenty-eight days	1,030	563	12,196	6,596

It is claimed for the cement that it is immune from attack by sea water and water containing sulphur compounds—which, as Mr. Butler points out, have sometimes been responsible for unsatisfactory work in which Portland cement has been employed—and experiments by responsible French engineers are put forward in support of this claim. Its rapid hardening qualities should, says Mr. Butler, render it very valuable for constructive work, such as street repairs, in which time is the chief consideration; but, he adds, until means are found of producing it more cheaply—the cost of production at present being somewhere about double that of Portland cement—it does not appear likely to become a serious rival of the latter for ordinary constructive work.

Arc-Welding a Fractured Ingot Stripper Ram.

THE following particulars regarding the repair, by arc welding, of the fractured ram of an ingot stripper have been sent to us by the Westinghouse Electric and Manufacturing Company, of East Pittsburg, Pa.

It appears that the ram was 10in. in diameter, and that it was broken off about 3ft. from the lower end. With the ram lowered to the extreme limit, the broken end was still between the tongs, and only about 20in. below the housing of the ram. At the upper limit of travel the broken end would be well up in the housing, a circumstance which eliminated the possibility of leaving any reinforcement at the point of the break. After deliberation it was decided to attempt to effect a repair by means of arc welding, and to proceed along the following lines :—

A new tip for the ram was prepared from new steel stock, leaving the upper end of the piece cut off flat on the end at right angles with the axis of the piece. The stub end of the ram was then bevelled off from two sides to form a blunt chisel end, the point for starting the cut for each face being about 5in.—that is to say, half the diameter—above the end of the ram. Each face was cut parallel with a plane through both of the tongs, so as to be easily available to the welder, and not to have the tongs in the way. The new tip was then secured in position, and proper alignment with the ram obtained by means of two bolts on opposite sides of the pieces, these bolts passing through two clamps, one secured near the upper end of the tip and the other secured to the ram just above the bevelled faces. These bolts were arranged adjacent to the tongs, so as not to interfere with the welders.

The work was carried out during cold weather, and therefore to make it possible for the welders to work continuously, a platform about 8ft. square was constructed at the correct height under the ram, so that the welders could easily reach the surfaces to be welded. A housing and roof was constructed around and over this platform to protect the work and welders from the wind and snow. A stove was also provided in the improvised house to keep the temperature sufficiently high for the men to work with comfort, which is absolutely essential for good welding work.

This job took nine hours to complete, so that, with two welders, eighteen man-hours were taken up, while approximately 100 lb. of $^{5}/_{16}$in. diameter electrodes were consumed. The alignment of the new tip with the main portion of the ram is reported to have been almost perfect, so that after grinding off the excess weld metal the ram could be drawn up into the stripper boom without any binding. This accuracy in alignment is attributed primarily to having two welders working on opposite sides of the ram and depositing an equal amount of metal on each side at the same time.

The cost of carrying out the work was, it is stated, much less than it would have been had it been effected by the former methods of welding, and the stripper was ready for service about twelve hours sooner, which is an important item. The following figures have been supplied to us in order to show the comparative costs with different methods of procedure. It will be observed that the cost of repairing a ram, even by the arc process, shows only a slight saving over the cost of a new ram, but it is pointed out that the loss due to the delay in obtaining a new ram would amount to several times this value, because of the length of time the stripper would be kept out of service.

	Dols.
Cost of new ram, 30ft. long, 10in. diameter	200.00
Cost of removing old ram and installing new ram	100.00
Total	300.00
Cost of effecting weld by old method	500.00
Cost of preparation	48.50
Cost of finishing	5.00
Total	553.50
Arc welding : Cost of labour and material	200.00
Cost of preparation	33.50
Cost of electric power	6.00
Cost of finishing	2.00
Total	241.50

It will be seen that these figures show that by adopting arc welding a saving of 312 dollars, as compared with the "old method" of welding—the nature of which is not explained in the particulars which have been sent to us—was effected.

Federated Malay States Railways.

THE following information has been abstracted from the summary of the annual report on the Federated Malay States Railways for 1922, which has been issued by Mr. P. A. Anthony, C.M.G., General Manager and Chief Engineer :—

In spite of the trade depression, the results of the year's working showed a profit of £233,801, compared with £58,567 in 1921 and £65,683 in 1920; but it is pointed out that these results have only been obtained by the postponement of maintenance work, such as repairs to rolling stock, renewal of sleepers and repairs to buildings. Two important events took place during the year, viz., the visit of H.R.H. the Prince of Wales and the Malaya-Borneo Exhibition, which was opened by the Prince in Singapore. Satisfactory transport arrangements were made in both instances. The Administration ran thirty-eight special trains in connection with the former—some over a distance of 250 miles—and fifty-six in connection with the latter event.

It is also noteworthy to find the introduction of a system of train control on a busy section of the Federated Malay States Railways controlling the distribution of rolling stock and all train movements. The system has proved quite successful and will be extended. As regards telegrams alone—practically all train messages—the number was reduced by 368,000 compared with the previous year's figure. A further innovation was the introduction of special pay trains, two such trains paying the whole system in six days. Advantage was taken of running them to distribute "traffic stores" throughout the line, and they have also proved very useful to district officers visiting sections together. The year 1922 also saw the inauguration of a through fast weekly passenger service between Penang and Bangkok, *viâ* the Federated Malay States Railways and the Siam State Railways.

Capital expenditure during the year amounted to £1,494,325, as compared with £3,482,354 in the previous year, and included £1,117,221 for widenings, additions, new wharves at Prai and the Johore Causeway, £278,085 in respect of new lines, and £38,323 for new rolling stock. The total receipts from all sources amounted in 1922 to £1,611,904—a decrease of 14.71 per cent.—while revenue expenditure was £1,378,104—a decrease of 24.75 per cent. on the previous year.

Passenger traffic, which fell off in 1921, continued to decrease in 1922, and in consequence the passenger train service was curtailed. The decline continued till September, when a different policy was adopted, trains being put on again, while Sunday services were increased to the week-day standard, and fares on certain sections on which there was competition with hired cars, were reduced. This policy had the desired effect, and the remainder of the year showed a general recovery in numbers and receipts. For the year, ordinary passengers showed a decrease of 2,111,782—20.02 per cent.—compared with 1921, while passenger receipts fell off by £177,037—21.74 per cent. Train mileage showed a decrease from 3,944,990 in 1921 to 3,401,721 in 1922, or equivalent to 13.77 per cent.

Of new works in hand, the most important are the wharves at Prai, which are now in use and nearing completion, and the Johore Causeway, which will connect the island of Singapore with the mainland. Trains will, it is anticipated, be running over the Causeway before the end of the present year. The East Coast line through Pahang and Kelantan is still being pushed ahead. The Penang Hills Railway, which will bring the hill station—which stands at an altitude of 3000ft.—within half an hour of the town, is also almost finished and will be opened for traffic during 1923. On the other hand, certain works have been closed down until the financial situation improves. The open line mileage at the end of 1922 was 1022 miles.

The general depression in trade affected the Federated Malay States very severely. Tin and rubber are the main sources of revenue, and in consequence of the serious drop in the price of both these commodities the revenue suffered to such an extent that it became necessary to resort to a policy of drastic retrenchment, and consequently railway expansion was considerably curtailed.

The Welland Canal Development.

THE following particulars regarding the Welland Ship Canal appeared in a recent issue of our Canadian contemporary, the *Contract Record and Engineering Review* :—

The close of the 1922 construction season saw a little over one-third of the construction work on the Welland Ship Canal completed. Good progress was made last year on several sections of the work, yet an even greater programme of work is planned for execution this year, the Government having set aside a sum of 11,800,000 dols. to finance the season's work, whereas the last year's apportionment was 8,000,000 dols. From an engineering standpoint it is estimated that this work could be completed within the next five years, but it is not expected that it will actually be completed for about nine or ten years, as the work undertaken each year is limited by the amount of money the Government can afford to set aside for this purpose. Abnormal prices of labour and material during the war resulted in a temporary suspension of operations, the contractors finding it impossible to operate on the terms of the original contract, and the present-day high prices are still materially affecting the amount of work undertaken each year. Yet progress may be said to have been steady during the past few years, and the huge contract is fast taking the form of the great waterway that it will ultimately become.

This project, from the viewpoint of size and importance, is the largest engineering contract under way in the world to-day, and is second only to the Alabama Muscle Shoals power scheme in so far as actual amount of money involved is concerned. At the height of the working season last year a force of about 2500 men was employed. The ultimate cost will be approximately 100,000,000 dols., though it was stated before starting the work that 55,000,000 dols. would cover the entire construction.

The canal will be 200ft. in width throughout its 25 miles of length, and on completion will enable the large grain carriers to go as far as Kingston, which will mean a considerable saving in the cost of transporting grain to the Atlantic seaboard. Its full value, however, will not be realised, engineering authorities claim, until it has been connected up with a similar system of waterways in the upper St. Lawrence.

CANAL CAPACITY.

Provision is being made for a depth of 30ft. of water on the sills of the locks, although the reaches are at present only being excavated to a depth of 25ft. Incidentally, it is pointed out that dredging the remaining 5ft. of depth, when desired, can be carried out more economically than excavating the full 30ft. at the present time.

The course of the old canal is followed closely from Port Colborne to Allanburg. The ship canal is at an altitude of 568ft., where it crosses the present canal at Lock 25. It takes a new channel between Allanburg and Thorold, avoiding the irregularities of the present canal. The most noteworthy features of the ship canal are near Thorold, where there are three twin locks in flight, similar to the much-advertised Gatun Locks of the Panama Canal. The valley of Ten Mile Creek is followed quite closely from Thorold to Port Weller. The present canal is crossed at Lock 11, where the altitude is 382ft.

CONSTRUCTION DETAILS.

The new canal will comprise seven locks, a vessel passing through being lowered a distance of 326ft. from the level of Lake Erie to the Lake Ontario level, the locks being so constructed that they will fill in eight minutes. The total length of time required for a vessel to pass through the canal will be eight hours, it is expected, or about half the time required to travel the length of the present canal. Each lock will lift a vessel a height of 46½ft., compared with a maximum lift of 26ft. on the Panama Canal.

The concrete work is of tremendous proportions. Sixteen million cubic feet of concrete was cast in the locks under construction last year. It is estimated that over half of the huge total of 40,200,000 cubic yards of earth excavation has been completed. The total amount of rock excavation will be 6,740,000 cubic yards, of which, also, a considerable percentage has been completed. The water-tight embankments make a total of 2,700,000 cubic yards of concrete and about 18,500,000 lb. of reinforcing steel will be used.

This season should see Lock No. 1, the Port Weller section, about completed, there remaining only about 10 per cent. of the work on this section to be completed. Lock No. 2 is nearly as far advanced, and in Locks Nos. 3 and 4 the excavating has been partially completed and concreting work will proceed this year. Considerable excavating has been done on Lock No. 5, and concrete work is well advanced on twin Lock No. 6 and has been commenced on Lock No. 7. The work so far has been on the section from Lake Ontario to Port Robinson, no start having been made as yet on the remaining section to Lake Erie.

Of special interest is the section of the canal in the Thorold district, where the steep descent of the Niagara escarpment is encountered. Within a space of one mile in this section four of the locks are located, making a total drop of 186ft.

GATES.

The lock gates will be of the single-leaf type, swinging on a hinge at one side of the lock and resting in a notch cut in the opposite wall. The lock gates will be 88ft. in length, 83ft. in height and will weigh about 1100 tons. Side ponds or regulating basins will be formed to fill all locks, thus eliminating objectionable surges and currents that might otherwise be caused by filling from the canal above.

American Engineering News.

(From our own Correspondent.)

A BOILER FOR 1200 LB. PRESSURE.

THE latest development in the use of high steam pressures is a boiler now being built for the central station plant of the Chicago Commonwealth Edison Company, which is designed to carry 1200 lb. pressure. The steam will be supplied to a small experimental turbine, which takes it at boiler pressure and exhausts at 300 lb. pressure into the steam mains of the large turbines which form the normal equipment. This water-tube boiler is of the Babcock and Wilcox type, with inclined headers and a steam drum at right angles to the tubes. At the upper end of the headers are seventeen rows of 2in. tubes, 15ft. long, and at the lower end eight rows of similar tubes. Between these two sets are the superheater tubes, and above the top set are 3½in. horizontal tubes leading to the 48in. drum. The lower tubes are about 25ft. above the chain grates. A baffle causes the gases to make two passes through the upper set of tubes. Boiler heating surface is about 15,750 square feet; primary superheater, 2120 square feet; secondary superheater, 3300 square feet; economiser heating surface, 9230 square feet. The drum is a 48in. forged steel cylinder, 25ft. long and 4in. thick, with integral heads having manholes. The headers are ⅞in. and 1¼in. thick, and the tubes are staggered 4in. in alternate rows. The mud drum at the bottom of the back header is also a steel forging, 8in. square and 1in. thick. It extends through both ends of the boiler setting and has flanged ends for the blow-off valves. The primary superheater is designed to raise the temperature of the 1200 lb. steam to 750 deg., and the secondary superheater to raise the 300 lb. exhaust steam from the turbine to 750 deg. The complete boiler unit is 45ft. high, 28ft. wide and 36ft. deep, including the economiser behind the boiler.

USE OF TIN-PLATE SCRAP FOR CAST IRON.

AFTER various experiments in the de-tinning of tin-plate scrap in electric furnaces, with unsatisfactory results, the next step was to determine what effect tin had on cast iron, and whether suitable castings could be made from tin-plate scrap. Favourable results have been reported in a paper presented to the American Electrochemical Society. Tests on foundry pig showed that tin increases the hardness, but decreases the strength by about 15 per cent. if the tin is more than 1 per cent. Castings machined easily and showed good fractures. It is considered, therefore, that tin-plate scrap or old tin cans can be used in the production of synthetic grey iron for the ordinary grade of castings, provided the tin content is kept at 1 per cent., or less, scrap free from tin being added to lower this percentage. The following conclusions were presented :—(*a*) It is impossible to remove most of the tin by electric furnace melting processes; (*b*) no tin is volatilised ordinarily when iron scrap containing it is melted in such a furnace; (*c*) the amount of tin volatilised in the cupola may be from zero to 50 per cent., depending on the amount of tin surface exposed and the oxidising condition of the blast; (*d*) lead and zinc can be removed from iron by melting in an electric furnace; (*e*) a tin content up to 1 per cent. does not seriously affect the physical properties of cast iron; (*f*) under ordinary conditions tin cans and tin-plate scrap cannot be detinned profitably, but such material can be used efficiently by treating it in the electric furnace to produce synthetic cast iron, using low-grade iron scrap, free from tin, to keep the tin content within safe limits.

MALLEABLE IRON MANUFACTURE.

ABOUT 95 per cent. of the iron for malleable castings in the United States is melted in air furnaces, the remainder being melted in cupolas, open-hearth furnaces and electric furnaces, according to a paper by M. M. Watkins, engineer for the Brown Instrument Company, of Philadelphia, which company manufactures pyrometers for furnace work. As a rule the furnace has a roof of sections removable for charging and for repairs. Forced draught of 3 oz. to 4 oz. pressure is generally employed, but a few furnaces operate with natural draught. Bituminous coal is the usual fuel, but oil and pulverised coal are used to a limited extent. There are about as many different types of annealing ovens as there are malleable iron foundries, and several foundries have from two to six types of ovens in the same shop. More attention is now being given to oven design to ensure proper thermal conditions and to meet the following conditions :—(1) To bring the oven up to uniform heat quickly, or in twenty-four to thirty-six hours; (2) to maintain this heat during the soaking period of about sixty hours; (3) to cool the ovens not more than 10 deg. Fah. per hour at first, and then more rapidly after the temperature has fallen to 1000 deg.; (4) to complete the annealing as rapidly as possible, or in about seven days; (5) to lower the cost of fuel and labour; (6) to reduce maintenance charges, and (7) to give increased life to the annealing pots. To ascertain the temperature of the castings, the most accurate method is to insert thermo-couples in the annealing pots. Malleable iron foundries are slow to use this method on account of the expense due to the short life of the thermo-couples. The usual method, therefore, is to install thermo-couples passing through the wall of the oven. Few ovens are alike in heat distribution, however, and thermo-couples may be used to ascertain this dist ibution, so that necessary changes can be made to secure uniformity of heat.

Books of Reference.

Hütte des Ingenieurs Taschenbuch. Vol. I. 9s. net. Wilhelm Ernst and Sohn, Wilhelmstrasse, 90, Berlin W. 66. —The twenty-fourth 1923 edition of this well-known German handbook appears for the first time in three volumes, the first of which is to hand. It extends to over 1300 pages, and has been considerably enlarged. The earlier chapters on mathematics and mechanics have been rewritten and new material on vector calculations added. The sections on heat and the strength of materials are comprehensive, and special attention has been paid to the subject of lubrication and of belts and belt-conveyors. In the later chapters a full account of machine details is given, the chapter dealing with governors having been rewritten. The tables in the appendix include a series on European coinage and weights and measures, and a list of German engineering standards up to October 28th, 1922, is given.

The Directory of Shipowners, Shipbuilders and Marine Engineers. 1923. Price 20s. net. Published by the Directory Publishing Company, Limited, of 33, Tothill-street, Westminster, London.—The new edition of the directory marks the twenty-first year of publication. Information is given concerning the leading steamship companies, shipbuilders, ship repairers, and marine engineering works throughout the world. A supplementary section includes a list of societies, institutions, trade and labour federations, and a directory of consulting naval architects and marine engineers. The new edition contains a large amount of foreign information, and the pages devoted to German shipping indicate its significant growth in the last two years. The volume is convenient and handy in form, and one which will be found indispensable to all interested in ships and shipping.

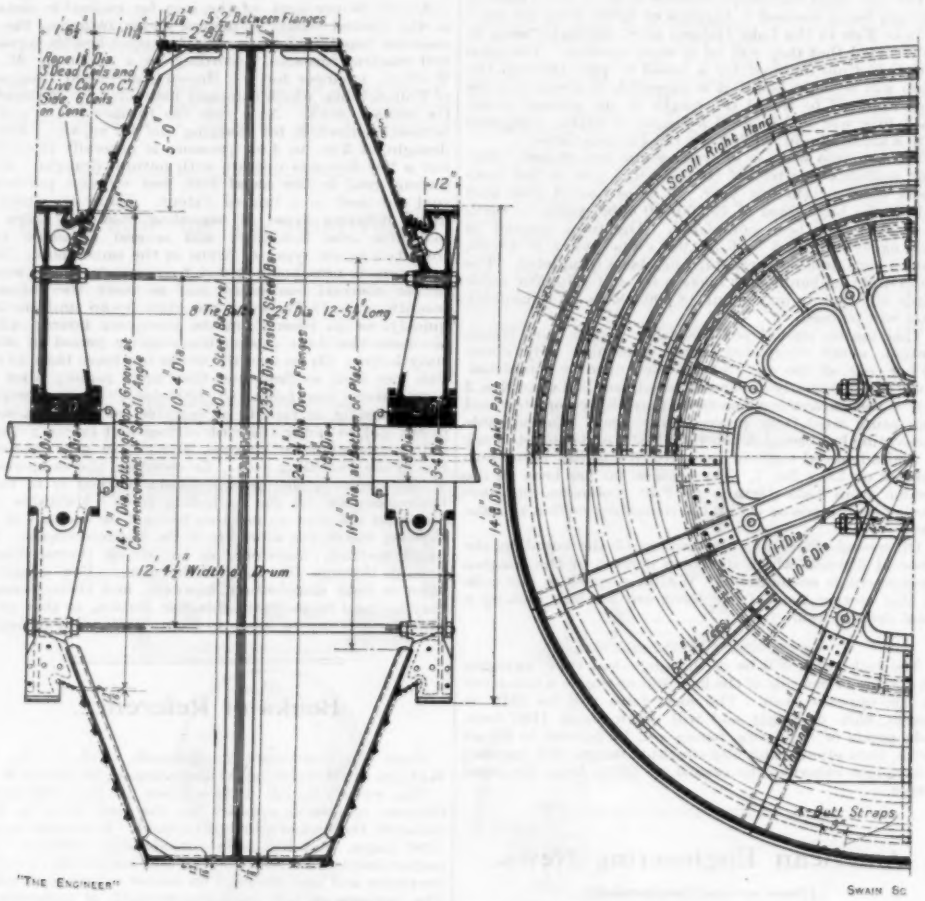
THE INSTITUTION OF STRUCTURAL ENGINEERS.—Under the auspices of its Western Counties Branch, which was responsible for the arrangements, a large number of members of the Institution of Structural Engineers paid a visit on Saturday, June 16th, to Gloucester. After the party had been welcomed by the Mayor of the City, visits were paid in turn to the Cathedral, an Exhibition of Artificial Stone, and the Exhibition of Gloucester Industries. A meeting in the evening was addressed by the President of the Institution (Mr. Etchells), the President-elect (Major Petrie), and the Chairman of the Western Counties' Branch (Mr. Pimm), and reference was made to the recent remarkable growth and development of the Institution.

A Large Winding Drum.

As a part of the improvements at the Bertie Pit, Trehafod, of the Lewis Merthyr Consolidated Collieries, Limited, it was decided some time ago to replace the drum of the winding engine. These alterations are not only of topical interest, as they have now approached completion, but they are also noteworthy on account of the great size of the new drum, which was made by Robey and Co., Limited, of Lincoln, and which, as will be seen from the accompanying drawing, is 24ft. in diameter by some 12ft. in width.

This drum is to replace an existing one which has been in use for a considerable number of years, and which has recently caused the engineers some anxiety. The chief engineer of the colliery—Mr. Evans—was faced with several difficulties. The drum had of necessity to be somewhat special in design, and it was essential that it should be placed in position with the least possible stoppage of the pit. On account of the very limited width between the main bearings of the engine, special provision had to be made for the dead coils of the rope on the smaller diameter of the drum, and, as will be seen from the drawing, these coils are arranged to run underneath the brake path.

In order to enable the change to be made in the shortest possible time it was decided to build the drum up on its new shaft and roll the complete shaft and drum into



THE NEW WINDING DRUM AT THE BERTIE PIT, TREHAFOD

position. A large excavation in front of the existing engine was taken advantage of for this purpose, and substantial walls were built from the bottom of the pit up to a height coinciding with the top of the main bearing cap, as shown in the engravings on page 662. The shaft was then laid across these two walls and the drum built up in position. It is expected to make the change in an ordinary week-end stoppage. One of the illustrations on page 662 also shows the existing winding drum in its place in the background.

The new drum, it will be seen, is of the semi-conical type, the small diameter being 14ft., rising to 24ft. at its largest diameter. The drum sides are cast iron, with a brake rim on each 14ft. 8in. diameter by 12in. wide, carrying ventilated brake paths formed by steel strip. The drum sides are made in halves, bolted together and fitted with shrinking rings at the bosses, and are secured to the shaft by two keys. Eight through bolts, 2¼in. diameter, tie the drum sides together, and take the end thrust from the cones. Each cone is constructed of steel plate ⅝in. thick in eight sections, the steel tee stiffeners being 6in. by 4in. by ½in., and riveted at the joints to internal channels 10in. by 3½in. by ½in. The steel rope-section spiral is riveted on to the cones. The parallel part of the drum at its largest diameter is of steel plate 1¼in. thick in four sections, with longitudinal internal butt strips for securing each section. This plate is 5ft. 2in. wide, and riveted at each end to corner angle plates, the latter being riveted in turn to the steel cone plates. It will be seen that the centre stiffening ring consists of two angles 8in. by 4½in. by ⅝in., with centre segmental plates 18in. deep by ⅝in. thick, riveted together and also riveted to the barrel plate.

The pit shaft for which this drum has been built is 403 yards deep, and the winding conditions are as follows:—When on coal work the load, including coal, tubs, cage and chains, is nine tons, but when winding rubbish it is increased to ten tons. The rope used is 1⅜in. diameter, of the flattened strand type, having a breaking strain of 120 tons, the approximate weight being 31.3 lb. per fathom.

Whitworth Scholarships for 1924.

THE Board of Education has recently issued the regulations for the Whitworth Scholarships which will be offered for competition in 1924. The Scholarships which are to to be awarded on the result of an examination to be held in May of that year, are as follows:—(*a*) Six Whitworth Scholarships of an annual value of £125, which may be increased in special cases if the Board thinks fit, tenable for three years; and (*b*) two Whitworth Senior Scholarships of an annual value of £250, tenable for two years.

GENERAL QUALIFICATIONS REQUIRED OF CANDIDATES.

Each candidate must possess the following qualifications:—

(*a*) He must be a British subject.

(*b*) He must be of sound bodily constitution and of good character.

(*c*) He must have been engaged in handicraft * in a mechanical engineering workshop during ordinary working hours for periods amounting to at least thirty months † at some time before May 1st of the year in which he competes. Of these thirty months, not less than three months must have been spent at the lathe, and not less than three months at fitting or erecting, and the sum of the periods devoted to the lathe and to fitting or erecting must be at least twelve months.

The Board may modify the conditions with regard to the candidate's workshop experience provided that he has spent the full period of thirty months in handicraft in mechanical engineering workshops, and that it is satisfied as regards the adequacy of that training for the purpose of his future development as a mechanical engineer.

(*d*) He must have attained sufficient handicraft power.

The Board may require any candidate to satisfy it of his qualifications in this respect either by a practical test or in such other way as it may consider suitable. In such a case he may be required to attend at a place indicated by the Board to make the test. If this place is at any considerable distance from his place of residence the Board may allow expenses on a scale which will be notified to him at the time.

(*e*) He must submit for examination laboratory note-books, signed and certified by his teacher in respect of practical work done by him. The laboratory note-books must relate to work of a standard appropriate to the examination in the competition for which he has entered.

Any candidate who does not submit evidence of the performance of a satisfactory amount of experimental work of a standard appropriate to the Examination will not be regarded as qualified to receive an award. The examiners may also take into consideration the evidence provided by the laboratory note-books in making the awards.

EXAMINATION FOR WHITWORTH SCHOLARSHIPS.

The candidate must not have completed the twenty-first year of his age on May 1st (*i.e.*, he must have been born on or after May 2nd, 1903).

Papers will be set in the following subjects:—

(1) Machine Construction and Drawing,
or
Naval Architecture.
(2) Mathematics. (Two Papers.)
(3) Applied Mechanics. (Two Papers.)
(Including Analytical Mechanics, Strength of Materials, Structures, Machines and Hydraulics.)
(4) Heat Engines,
or
Electrical Engineering.

Laboratory note-books will be required to be submitted for examination in respect of work done in applied mechanics and either heat engines or electrical engineering.

Whitworth Prizes will be awarded to the unsuccessful competitors for Whitworth Scholarships whose work appears to deserve recognition. These prizes will not exceed twenty-five in number and will be of the value of £10 each; the money must be spent on books, instruments or apparatus for the furtherance of the competitors' engineering studies.

EXAMINATION FOR WHITWORTH SENIOR SCHOLARSHIPS.

The candidate must not have completed the twenty-sixth year of his age on May 1st (*i.e.*, he must have been born on or after May 2nd, 1898),‡ and must not have previously held a Whitworth Senior Scholarship.

Papers will be set in the following subjects:—

(1) Construction and Design of Machinery,
or
Naval Architecture.
(2) Mathematics. (Two Papers.)
(3) Mechanics.
(4) Heat Engines.
(5) Strength of Materials and Structures.
(6) Theory of Machines,
or
Hydraulics and Hydraulic Machinery,
or
Electrical Engineering.
(7) Engineering Graphics.

The standard of the examination will be such as may be reached by candidates who have taken a course equivalent to that leading to an honours degree in a university. A fundamental knowledge of physics and chemistry will be required and tested in the papers on teachnical subjects.

Laboratory note-books will be required to be submitted for examination in respect of work done in heat engines, strength of materials, and either theory of machines, hydraulics, or electrical engineering.

The names of any unsuccessful candidates for Whitworth Senior Scholarships who appear to deserve honourable mention for their work in the competition will be announced in the award list.

CONDITIONS AFFECTING BOTH CLASSES OF SCHOLARSHIPS.

Scholarships awarded under these Regulations are not tenable with any other award without the written approval of the Board.

A scholar will not be permitted during his tenure of the Scholarship to take any place or profit, or to enter or continue in any business, save in very exceptional circumstances and with the written approval of the Board.

When a scholar is prepared to forego financial assistance, or when the Board considers that the normal amount of the Scholarship is not required, an honorary award may be made, or the amount of the award may be reduced below the sum named.

Each successful candidate will be required during the tenure of his Scholarship to devote himself entirely to the prosecution of his training as a mechanical engineer, and for that purpose to submit for the approval of the Board a scheme showing the course of work which he proposes to undertake. The tenure of the Scholarship will be subject to the condition that the holder pursues the approved course to the satisfaction of the Board. A candidate may be required to attend at the offices of the Board in person in order to submit a scheme of work, in which case expenses will be allowed on a scale which will be notified to him at the time.

The tenure of a Scholarship will normally date from August 1st following the Examination, but it may be deferred with the written approval of the Board.

APPLICATION FORMS AND GENERAL ARRANGEMENTS.

Intending candidates must make their applications for admission to the Competition on the prescribed form not later than February 1st, 1924. Copies of the prescribed forms and further information may be obtained from the Board of Education, Whitehall, London, S.W. 1.

GREAT improvements are to be made in the East Coast services to Edinburgh, Glasgow, Aberdeen, &c., in July, also to Leeds, Bradford, &c., over the Great Northern section. In addition to the non-stop run of a new "Pullman Limited" to Leeds and thence to Harrogate—mentioned in this column on April 13th and 20th—an express for Scarborough will run non-stop to York, 188 miles.

* Work in the drawing-office is not regarded as handicraft for the purpose of these regulations.

† Time spent during ordinary working hours in receiving theoretical instruction does not count towards making up the periods specified, and where a candidate has been engaged during part of the ordinary working hours in receiving theoretical instruction, the number of working hours during which he is actually engaged in handicraft must be equivalent to the number of working hours in the period of thirty months, three months, or twelve months, as the case may be.

‡ A candidate who served with H.M. Forces during the war may deduct from his age a period equivalent in length to such service.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

New Structural Steel Prices.

THE chief development in the Midland market during the week has been a further drop of 5s. per ton in structural steel prices. Business has been much less active of late. Standby orders enable business to be carried on fairly well by the large concerns, but fresh business is hard to find, and the inquiries at the moment are not exactly inspiring. Although production costs remain high, it has been found politic to allow some further reductions in selling rates, and a 5s. per ton drop on angles, sections, joists, &c., has been put into operation. The new prices are:—Angles, £10; sections, £10; joists, £10; tees, £11. It is reported that orders for angles have been accepted at even less than this figure. There is very little business passing in plates, but leading houses, at all events, adhere to their quotations. Small steel bars, though nominally £10 15s., can be bought at something less—£10 10s. being named in some quarters as the figure at which business has passed this week. The Belgians are cultivating the finished steel market with some energy, quoting joists at £7 15s. f.o.b. Antwerp—equal to £9 delivered—or about £1 below the native figure. In at least one case still lower prices have been quoted, but there are certain variations in the way of extras which bring the price very nearly to the higher figure. Delivery is promised within a month. The reduction in steel prices is said to be the sequel to the falling off in specifications and the approaching exhaustion of orders. But the works are still making very good production, as is shown by the figures for May just published by the National Federation of Iron and Steel Manufacturers. The output of steel ingots and castings was 821,000 tons, as compared with 749,400 tons in April, and 802,500 tons in March. The production is much the best for the past twelve months. Compared with a pre-war average of 638,600 tons, it is considered on all hands to be very favourable. A good deal of miscellaneous steel is being turned out, and a rather hopeful sign is the gradual increase in building requirements. Some heavy contracts have been kept back pending the stabilisation of prices, but a recovery of the market is expected in the autumn, for some rather big work is known to be pending, while the railways have large arrears in the way of track laying and rolling stock to overtake.

Billet Values.

Semi-finished steel prices, on account of keen competition, still tend downward, and while some sellers continue to ask £8 10s., others are content to sell at from 2s. 6d. to 5s. less. Prices move very jerkily however. Cheap billets from Belgium continue to unsettle the market. Belgian supplies have been offered this week at as low as £7 10s., and in at least one case £7 7s. 6d., delivered in this district. A considerable proportion of such business as is completed is going abroad, but the tonnage is not considered to be heavy. Nevertheless, local steel makers are compelled to accept lower prices or lose the business. Steel strip for tube making is increasingly called for at £11 10s.

Scrap.

Steel scrap has become nearly unsaleable again, but for urgent requirements it is possible to buy favourably round about £4 per ton. Consumers have fair stocks in reserve, and are disposed to wait for still lower prices, especially as rather large quantities of foreign material continue to be available at prices well below native quotations.

Blast Furnace Activity Reduced.

There has been very little change in the pig iron situation in the Midlands during the week, but activity at the furnaces in the Black Country has been reduced. Output approximates closely to consumption, and stocks are negligible. The price concessions which have been made have not stimulated buying; on the contrary, they are an incentive to continued abstention, with the prospect that under pressure of necessity producers will yield further. Coke has changed hands at 28s. 6d. at ovens this week, which is 6d. less than was the case last week, but this was due to some local dislocation, and the general price level is unaffected. There seems to be no better hope of cheaper coke than there has been for some time past. There are strong complaints by Midland smelters about the absence of profit, and it is generally agreed that the production of pig iron to-day is far from profitable. Coke costs quite £2 a ton at the furnaces, and the maker bases his calculations on 30 cwt. of coke per ton of iron made, equivalent to an expenditure on fuel alone of £3 per ton. The sickness of demand and the impossibility of harmonising production costs with selling prices, such as might bring business, are combining to make it extremely difficult to continue operations at some of the furnaces which have been restarted of recent months. One Black Country furnace has already been damped down, and elsewhere the activity of smelting plants has been reduced. This is greatly to be regretted, for last month's production was extremely satisfactory, the figures for the country as a whole being 714,200 tons, or nearly 60,000 tons in excess of the April output. It is feared that under present circumstances such excellent results cannot be looked for during the current month. Pig iron is being bought at date only in very small quantities, and Derbyshire and Northamptonshire smelters who are not well placed for orders are lowering their prices in the hope that they will avoid putting iron into stock at production costs which may have no relation to market values when the opportunity for realisation comes. Prices of foundry numbers have not been quotably changed since last week. Some low figures are mentioned for forge qualities, but they have not definitely displaced ruling values. No. 3 Derbyshire continues to command about £5 5s., and forge £4 17s. 6d. Northamptonshire costs about 2s. 6d. less in each case. There is not enough business to test the market.

Finished Iron Prices.

I regret to have to state that the outlook in the Staffordshire finished iron trade is anything but bright. For some time past orders have been getting scarce, until to-day quite a number of works are practically without orders, and there is a good deal of idle plant. Those firms which have business on their books are only partially employing their plant, activities being restricted to two or three mills. Marked bars continue at £14 10s., with moderately good employment, but the makers of unmarked iron are quite unable to realise the nominal figure for their product. Makers of Staffordshire Crown bars are accepting orders at from £12 to £12 5s., though the nominal figure of £12 10s. is still maintained. Prices are weakening, not because this is justified by a reduction in production costs, for the reverse is actually the case, wages having gone up 7½ per cent., but because demand is poor and competition is keen. Demand for nut and bolt bars is at a low ebb, and there are Black Country bar makers who, it is said, are, under pressure, accepting even less than £11 5s., though this price is considered unremunerative. Lancashire houses make £11 5s. the minimum, and ask 2s. 6d. extra for fencing iron. Continental producers continue their efforts to secure the limited amount of business which comes on to the market. This week nut and bolt makers in the Darlaston district have been offered bars at £7 5s. f.o.b. Antwerp, which is equivalent to about £8 10s. delivered here, and in so far as there is any demand it is largely diverted from home mills, although they are in such sore straits for employment. It is only because the requirements of the nut and bolt trade are so meagre at the moment that the amount of business which is going to the Continent from this district is as small as it is. Iron gas tube strip is selling this week at £12 15s. to £13. It is still more than £1 dearer than steel strip, and tube makers, consequently, are using more of the latter material.

Cheaper Galvanised Sheets.

There is a fair amount of activity at the local sheet mills, makers having order books sufficiently good to keep them busy until the autumn. Consumers are not satisfied with the recent price concessions, arguing that they are not equivalent to the fall in sheet bars, spelter, &c. They continue to press for reductions, and this week makers of 24 gauge corrugateds have in many instances conceded a further 2s. 6d. per ton, bringing the price down to £19 2s. 6d. Other mills, however, continue to ask £19 5s. Black sheets are also easier in price, orders having been placed this week at prices ranging from £13 10s. to £14. They are not being called for to the same extent as recently, owing to some falling off in business in the motor engineering industry.

Rolling Stock Business.

Railway wagon building and rolling stock firms in the Midlands are not getting new business so fast as old contracts are being worked off. They hope, however, for further support from the home railways as development plans ripen. The enterprise which private traders showed a few months ago in reinforcing their stocks of wagons has come to an end. Comparatively few orders are now being received from that quarter. The export trade continues disappointing.

Competition in Edge Tools.

The heavy edge tool industry in this district continues in much the same condition as I described in my letter a fortnight ago. The markets of the East, India and the Dominions show some improvement, however, but competition from Germany and America is becoming increasingly keen in many of the oversea markets. Prices remain firm.

Freeing the Flooded Mines.

The pumping operations at Waterfall-lane, Old Hill, are proceeding so satisfactorily that the owners of flooded collieries in the neighbourhood are contemplating an early resumption of operations at many of the pits. Not only are preparations being made for the reopening of some of the mines closed after the 1921 strike, but I understand that the old Haden Hill Colliery at Waterfall-lane is likely to restarted. The pumping plant of the pits will shortly be set in motion to help in freeing the workings of water, and it is expected that in a month or two it will be possible for the miners to descend to carry out road repairs.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE markets generally remain very much depressed and the outlook is not promising. Iron and steel seem to be rather worse than metals, but this may be accounted for by the fact that metals are down to a fairly low level of prices, whereas this is not the case with iron and steel, and particularly so in the case of pig iron, billets, &c. There seems to be a rapidly growing opinion here that a considerable fall in selling prices will have to be brought about before there can be any real revival of trade, and yet it is very difficult to see how the fall is to be accomplished. Selling prices are well up against the costs of production in most cases, and to get down the latter is a slow and tedious process.

Copper.

There has been some rather better tendency in copper of late, although no very considerable change in prices is to be expected. In fact, a steady market at about the present level would be much better for the trade than any rapid advance, which is almost bound to end in another collapse. The state of trade is certainly not such as to justify anything more than very moderate prices for copper for some time to come; and, according to all reports, there is plenty of profit in copper production even at present prices. In the market here there seems to be a belief that the Ruhr trouble is nearing a settlement, which will have a favourable effect on the consumption of copper. It is not easy to find any definite grounds for this belief, but there can be no doubt that if an arrangement between Germany and France could be arrived at it would be a stimulus, not only to the copper trade, but in other directions. It would soon make cheaper coal and iron possible, and after all this cheapness lies at the bottom of industrial prosperity. The official prices for manufactured copper and brass have not again been altered. One does not hear that much business is being done, and in this case, as in the case of bar iron, the slackness of work adds to the cost of manufacturing. According to the reports from dealers, the trade in scrap copper and non-ferrous metals is very quiet, and in fact not nearly so good as it was two or three months ago. When dealers find the demand falling off they usually reduce their buying prices irrespective of the markets for new metals; and this week, although standard copper and ingots are rather better, buyers offer rather less for scrap copper and gun-metal. The buying prices are, however, not very different from what they were last week. Tin has been rather inclined to weakness for some time, but there are now chances of a reaction towards rather better prices. The American spurt of buying has long been waited for, and yet has not arrived; but the idea is that it cannot be delayed much longer. The consumptive demand from Wales and from the Continent has also been small of late and may very possibly be ready for an increase. Lead has been quite a strong market and prices are inclined to rise a little. At any rate, the collapse in lead does not yet seem to be near. Spelter has been rather weak and fell below £30 per ton, but it has been a little steadier lately.

Pig Iron.

The markets this week for foundry pig iron seem to be quieter than ever. The demand is mainly for small lots for prompt use, and the aggregate of these does not amount to any large tonnage. It cannot be denied that the feeling in the market is considerably weaker, and this weakness seems likely to increase so long as the large consumers hold off. Their contention is that prices ought now to go back to the level which existed before the continental demand set in last February. This demand is now practically over, and the British ironfoundry trade needs cheap iron. Of course, the difficulty is about fuel, for the fuel costs of making pig iron are now roughly 20s. more per ton than they were at the beginning of the year. In spite of this high cost of fuel, however, the prices for foundry iron are gradually coming down. In the Cleveland district this week No. 3 could be bought at 1s. 6d. to 2s. below the ostensible price, and Midland makers are more inclined now to make concessions. As a rule sellers in Manchester quote 110s. delivered, but it would probably be possible to buy at 108s. 6d. This is, however, a long way from the 90s. or 92s. 6d. claimed by the ironfounders as a proper price, and one does not see how such a price can be reached within any reasonable time. It would be a question of selling iron at a considerable loss, and it may be that makers will blow out furnaces rather than incur the loss. They may stock the iron for a time, but they could not do this for very long.

Steel.

There is practically no change in the position of manufactured steel. Plates are still quoted here at £10 5s. to £10 10s., but there is no business. Joists and sections are quoted at £10, but probably a little less would be taken by merchants. Agents for continental steel are quoting £8 5s. to £8 10s. for joists and angles delivered here and in the Midlands, but one does not hear that much business is being done, although the price is low, and this is evidence that trade generally is restricted.

Scrap.

The demand for cast scrap remains poor, and even at 80s. per ton for broken machinery cast iron dealers are not able to find many buyers. One would think that founders would now buy this scrap for stock, because even if they succeed in getting the price of foundry pig iron down to 92s. 6d. in Manchester, this scrap at 80s. would still be quite a cheap foundry material. Steel scrap is weak, and the price at a Lancashire station is said to be about 70s. per ton. For heavy wrought scrap the ironworks are paying from 85s. to 90s. per ton.

Institution of Mechanical Engineers.

There was a very gratifying muster of members of the North-Western Branch of the Institution of Mechanical Engineers at a visit of inspection of Cammell Laird's works at Birkenhead on Wednesday, 13th inst. The gathering numbered about 120. On arrival at the main offices the members were divided into parties and conducted through the various sections of the works under the guidance of Mr. Willie Laird. In view of the prevailing depression in the shipbuilding industry, it was pleasing to observe that there is a fair amount of work on the slips or otherwise in progress at this establishment. Operations on the ships now being built are being held up by the unfortunate dispute in the boilermaking section. The chief attraction of the visit was the opportunity afforded to inspect the Camellaird-Fullagar engines, twelve of which are in process of construction for propelling through the medium of electric motors fruit-carrying vessels which are also being built by this firm. The engines under construction give 850 brake horse-power at 250 revolutions per minute, and tests carried out on engines of a similar type have shown that less than half a pound of fuel oil of a calorific value of 18,100 B.Th.U., specific gravity .878, and flash point 181 deg. is consumed per brake horse-power hour. At the conclusion of the visit a vote of

thanks was passed to Cammell Laird and Co., Limited, for their courtesy in permitting the members to view the works.

Robert Matthews.

Mr. Robert Matthews, whose death occurred last week, at the age of sixty-nine, had been living in retirement for some years. Formerly partner in the firm of Goodfellow and Matthews, of Hyde, Mr. Matthews was subsequently appointed manager of Armstrong, Whitworth and Co.'s Manchester works, and while filling that post he took an active part in local engineering affairs, such as the Engineering Employers' Federation, of which he was chairman for some time. He was also a member of the Institution of Civil Engineers and past-president of the Institution of Mechanical Engineers.

BARROW-IN-FURNESS, Thursday.

Hematite.

The tone in the hematite pig iron market is dull, and unless there is an improvement in business there is every likelihood of the output being restricted. This falling off in business is due to several reasons. It may be that the uncertainty of the Ruhr occupation and the prolongation of the prospect of settlement is holding off buyers, who await more settled conditions; and, again, it may be to a certain extent that the boilermakers' dispute is affecting both engineering and shipbuilding. The general opinion, however, is that it is due to a combination of causes and not to one alone, and that it will take a few months for matters to become adjusted. One furnace has already been put out of business at Cleator Moor, in Cumberland, and there is a possibility of more following suit in that county during the next few weeks unless there is a change. In view of the quietness in the steel trade in Cumberland, this reduction is having an effect upon the iron smelting industry, for very little is being taken by the steel works. Trade is now mostly confined to Scotland, the Midlands and South Wales.

Iron Ore

The iron ore trade is affected by the quieter conditions. One mine in Cumberland has stopped. A part cargo was sent from Barrow to Treport; but, on the whole, little is being dispatched outside the district. Foreign ore is only in moderate demand, and only one cargo was received from Kirkenes at Barrow last week.

Steel.

The steel trade, generally speaking, is dull, although the Barrow rail mills manage to keep going. The hoop and small bar mills are also at work. The orders held are fair, but the prospect for the future is dim, generally speaking. Foundries are not experiencing very good trade and their outlook is not so bright. In the engineering side there is a moderate amount of work. Vickers have secured an important order for the repair and overhaul of an oil tanker at Barrow.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trades.

THE dissatisfaction with the outlook in the open-hearth steel trade, which has been growing for several weeks, is now more pronounced. Buyers are still withholding their new orders, and the furnaces are to a preponderating extent engaged in the execution of contracts which were placed some time ago. They are still busy, but not quite so busy as they have been, and unless more business is placed it is pretty certain that, when firms begin stocktaking at the end of this month, a considerable amount of plant will have to be shut down. Consumers say that prices are too high, and their action has resulted in falling off in some directions, but makers declare that they might as well go out of business as make any reductions. The President of the Chamber of Commerce recently stated that he did not think there was any steel maker in the city who was making money. This statement receives support from the report of the directors of the Park Gate Iron and Steel Company, which states that, while the works have been fairly well employed during the past year, and the outputs satisfactory, it was necessary, in order to obtain orders, to make sales at a loss. The company's year's working resulted in a loss of £36,225, to be added to last year's loss of £139,699. The railway steel department continues moderately busy. South America has recently placed some good orders for axles, tires and springs. Extensive supplies are still needed, however, by the home railway companies, and producers of this class of material are renewing their complaints at the delay in placing the orders.

The Lighter Branches.

The position in the lighter branches is very much mixed. In some directions things appear to be looking up, but in others the opposite is the case, and much discouragement is felt. In crucible steel, a minority of firms report a rather better state of things; but, generally speaking, the depression continues very severe. The trade is still suffering greatly from the stocks of surplus material, made during the war, which remain in existence. These stocks are said to be very much mixed, and contain different classes of material which cannot be sorted out without patient analysis, with the result that people wanting a uniform quality find it advantageous to buy new stuff; but all the same the call for freshly manufactured products is interfered with by the surplus stocks. The best section of the light steel trade is that devoted to hand tools. Full employment is being enjoyed by makers of edge tools. Quite a satisfactory revival is reported in the demand for farm tools, heavy hammers, excavating tools, hand saws, axes, spades, shovels and products of a similar character. Good orders for such goods are being regularly received from the Colonies, India and South America.

Among the Optimists.

Quite an interesting little controversy is in progress between two of the leading industrial magnates of the city as to the trade outlook. Mr. Arthur Balfour, President of the Associated Chambers of Commerce, has joined the company of optimists. He expresses his conviction that no country in the world can produce goods as cheaply as we can, and that if we go out and get the trade we can reduce our unemployment. Mr. William Clark, the President of the Sheffield Chamber of Commerce, on the other hand, considers that Mr. Balfour is too optimistic. He emphasises that the needs of industry are cheap transport, cheap petrol, and cheap power. There is a growing demand for cheaper coal.

Cutlery and Plate.

There is little improvement to report in the cutlery and plate trades. A good deal of the business that is coming forward is producing scarcely any profit, and small makers are better able to take it than are large firms who have to meet expensive overhead charges. Some useful orders have come through from India, and have benefited the firms who have cultivated that market. While there has been a falling off in the demand for stainless steel cutlery, this section is still the busiest in the table knife department, and there is also a fair call for shear steel blades. The small improvement in the scissor branch, to which I have previously called attention, is maintained. The quantity of cutlery being sold over shopkeepers' counters is very unsatisfactory, and retailers say the present conditions are the worst they have known since the war.

A New Stainless Alloy.

The latest innovation announced in Sheffield is the manufacture of a new stainless alloy, which is claimed to excel in stain-resisting qualities all existing steels and irons. It costs more than nickel silver, but is said to have many qualities which compensate for that. It is declared to have exceedingly good mechanical properties, to be capable of being forged with equal ease, whether hot or cold, and of being rolled or drawn very thin. It is suggested that the new material might be used as a substitute for electro-plate and kindred alloys in the making of many articles. The alloy has been produced as the result of researches by Mr. H. Etchells, one of the inventors of the Greaves-Etchells electric furnace, and Mr. A. Popplewell, a director of L. C. Cameron and Sons, steel manufacturers, Sheffield. The material is being made up into spoon and fork blanks for the trade by William Gallimore and Sons, of Sheffield.

Sheffield's Asphalt Roads.

The use of asphalt for the making of roads which have to withstand very heavy traffic has been successfully introduced in Sheffield, and the experience of this city is attracting increasing attention from road engineers. Some very gratifying things were said about Sheffield's success at the Congress of the Institute of Transport, which was held in the city last week. Mr. A. J. Lyddon, Northern Divisional Road Engineer for the Ministry of Transport, described Sheffield as the Mecca of road engineers to-day, and said that the work of the city surveyor, Mr. W. J. Hadfield, in developing cheaper asphalt, both for tramway track construction and for other road works, was certainly of a pioneer character, and had now passed the experimental stage. It was an eye-opener to roadmakers to see what he had been able to do, not only from a wearing standpoint, but from an economical one. Mr. Hadfield himself, speaking at one of the sessions of the Congress, said that the asphalt pavement of Sheffield now extended to a quarter of a million yards. It was made by using up a waste product, namely, clinker from the destructor, which was mixed with Mexican bitumen. Some of this paving had been taking traffic of 4000 to 6000 tons a day for four years, and showed no signs of wear.

A New Power Station.

Nottingham Corporation has made a start with the erection of a super-power station, which will prove a great addition to the electricity resources of the East Midlands area. The station is being erected on the bank of the Trent at North Wilford, and the foundation stone was laid last week. Alderman Huntsman, the chairman of the Electricity Committee, said that the first section would cost about £730,000, and would give a production of 30,000 kilowatts. Their extensions, however, were only limited by the supply of water available, and he expressed the conviction that the station would ultimately have a capacity of 200,000 kilowatts, equal to 271,740 horse-power.

Colliery Development.

The latest colliery enterprise to be taken in hand in the district is that of Firbeck Main, in North Nottinghamshire, about 4 miles from Worksop. Sinking operations, which were suspended owing to the war, have been resumed. Simultaneously with the sinking of the colliery, a village of approximately a thousand houses is to be built. A housing site of 107 acres has been secured, which extends for practically half a mile on the Carlton–Oldcotes road. Plans have been prepared for fifty houses, the erection of which will commence immediately, and the others will probably be started in eighteen months or two years, according to the progress made in the sinking operations. The directors of Maltby Main Colliery, near Rotherham, report that good progress in further development has been made during the past year, and the output has been considerably greater than that of the preceding year, largely owing to the erection of new houses. Arrangements were made with the Industrial Housing Association for the erection of 224 houses, of which 112 have been occupied, and the remainder are in course of construction. House building will be continued until the directors are satisfied that the full requirements of the colliery have been met.

NORTH OF ENGLAND.

(From our own Correspondent.)

Serious Slump in Trade.

THE condition of trade in the North of England just now gives rise to grave anxiety. There is no confidence anywhere, and drooping prices are never a sign of commercial strength. The hopes expressed a few weeks ago of a general upward trend in trade seem to have been rudely shattered. Indeed, matters appear to have gone from bad to worse, and the outlook is very discouraging. The iron and steel trades are experiencing a very lean time, and manufacturers are becoming increasingly anxious to secure new orders to replace those now being quickly worked off. Prices are falling fairly rapidly, but the descent to lower values is a difficult process, and when buyers see so plainly that it pays them to wait, they are well content to do so.

Cleveland Iron Trade.

There has been a slight improvement in business in the Cleveland iron trade this week, but this is due to a large extent to the fact that several consumers have been compelled to buy iron for prompt needs. A little iron has been sold to Scotland, and a little also to the Midlands, this latter being somewhat significant when it is remembered that Midlands iron is so much cheaper than Cleveland. But the export trade is still very quiet, and whilst it is true that there are a few promising inquiries circulating, prices are still regarded as too high to permit of the resumption of a normal export trade. Ironmasters are still confronted with the absolute refusal of consumers generally to make forward contracts. They are simply covering their minimum requirements, and will continue to do so until prices become stable. This week prices have eased further, with the exception of No. 1 Cleveland foundry. There is extremely little of this quality on the market, and the makers resolutely refuse to cut below 127s. 6d. per ton. But No. 3 Cleveland is now quoted no more than 116s., and this figure can certainly be shaded for an order of any magnitude. No. 4 foundry is on offer at 112s. 6d. per ton and No. 4 forge at 110s. per ton.

Hematite Pig Iron.

There has been a big contraction in the demand for East Coast hematite pig iron and the weakness of the market is more apparent. There is the keenest competition for orders, and although mixed numbers are now offered at 115s. per ton for home use and export, that is not the minimum, and it is possible to place a decent order at probably 6d. to 1s. per ton less. No. 1 can be bought at a premium of 6d. per ton above mixed numbers.

Iron-making Materials.

The foreign ore trade is still absolutely idle and at many of the mines abroad output is being reduced, as it is difficult to get consumers to take deliveries under contract. The price of best Rubio ore is still quite nominal at 24s. c.i.f. Tees. The firmer tone of the coke market seems to eliminate any hope of cheaper pig iron. The export demand has revived, and sellers can dispose of their coke abroad at prices far above any which the ironmasters can pay. To the latter an entirely preferential rate is quoted, but only minimum supplies are available, and contracts are not being renewed below about 42s. 6d. per ton.

Manufactured Iron and Steel.

Whilst business in the manufactured iron and steel trade shows no signs of improvement, the gratifying news is forthcoming that Dorman, Long and Co., Limited, Middlesbrough, have decided to re-start their Port Clarence steel mills next week. The steel furnaces at these works have been operated intermittently, but the mills have not been in operation since September last. It is understood that sufficient orders have been accumulated to ensure reasonable continuity of working, but other firms are not so favourably placed. The shipyard lock-out still holds up shipbuilding specifications, and in other directions the demand is quiet. Moreover, users of billets are finding it cheaper to buy abroad, but northern manufacturers still refuse to cut prices.

The Coal Trade.

A more active inquiry is reported in the Northern coal trade, and the outlook has improved considerably. Business is now offering for July and also up to the end of the year, not only speculative, but also general for nearly every European country. Merchants are beginning to receive inquiries for Belgium, France, Denmark, Sweden, Norway, Lithuania, Finland, as well as Germany. Though there is no great volume of actual business being booked at the moment, there is some encouragement to regard the prospects of the forward market with more optimism than was justified a little while ago. Northumberland steam coals are steadier in tone, and although there is no alteration in prices either for best or second screened steams, there is less disposition to discount prices even in second-hands. Steam smalls are firmer and inclined to move forward in price. The Durham market is also a shade better and less irregular than it was. Wear specials, as well as the prime brands of gas coals, are rather more scarce in some cases and steady in price, while secondary sorts of gas coals are more uniform in value. The demand for coking coals keeps up and the whole situation of the coking market has undoubtedly improved. The bunker trade, however, is rather quieter and prices are easier. There is no change in the coke market. All kinds of foundry and furnace coke are moderately well inquired for, while gas coke is steady.

SCOTLAND.

(From our own Correspondent.)

Unchanged Outlook.

DURING the past week nothing has happened to improve the industrial outlook. The market for all

classes of steel and iron materials has been dull throughout, and prospects of future business are extremely cloudy.

Increased Unemployment.

The scarcity of business is resulting in the closing down of establishments in the Lanarkshire district. Several works in Motherwell are closed, and others are curtailing their working staffs. Cambuslang is also suffering from a lack of employment through the closing of the big rolling mill and the damping down of furnaces at the Hallside works of the Steel Company of Scotland, in which establishment the melting shop is now completely idle. In none of the cases mentioned is there likely to be a restart until after the annual fair holidays at the earliest.

More Shipbuilding Orders.

In view of the orders recently placed for new ships, and the probability of others to follow, it is most unfortunate that work at the shipyards should be held up to a large extent by labour troubles. Orders have been lost to allied industries, as in every probability cheaper foreign material will be available when work at the yards is fully resumed. Despite ruling conditions orders are still reported, the latest announcement being one for the building of two cargo steamers, each of 5000 tons, for the Adelaide Steamship Company, Limited, Melbourne, placed with Wm. Beardmore and Co., Limited, Dalmuir.

Easier Tendency of Markets.

The scarcity of orders for all descriptions of steel and iron is becoming more pronounced. Steel plates and sectional material are hardly in demand at all in the meantime, and old orders are fast running out. Prices are practically unchanged, but are really untested at present, and it is generally anticipated that easier terms will be available when orders are forthcoming. Steel sheet makers are not much better off. Home business is very limited, and export inquiries are almost entirely confined to the lighter gauges. Bar iron makers have gained next to nothing from the recent reduction in prices. Some of the mills are now on short time, and the situation appears likely to become aggravated in this respect. Re-rolled steel bars, too, are poorly bought. Pig iron is a very dull market. Hematite and foundry qualities have few buyers, and the output is being restricted, while quotations are gradually easing week by week. The scrap trade is suffering in conjunction with the other departments. Generally speaking, nothing in steel and iron materials is being bought apart from absolute requirements, which are of the most meagre description at present.

Coal.

The Scotch coal trade is sharing in the general industrial depression. Business has been extremely quiet, and almost without interest during the past week so far as fresh orders are concerned. Overseas consumers continue to hold off, and practically all shipments abroad are against old contracts. Prices are so unsteady and falling so rapidly that buyers are adopting a most cautious attitude and will consider nothing but immediate necessities. Shipping facilities have improved greatly, and old contracts are now being quickly overtaken and quieter times seem likely unless a quick change for the better sets in. Some collieries report that fuel is beginning to accumulate at the pithead, which is partly responsible for the cheaper prices now obtainable, but the downward movement is being accelerated by the forcing of supplies on the market by holders anxious to unload before their losses become greater. A considerable amount of undercutting is in progress, but is meeting with varied success. The coastwise traffic has been a little heavier, and with foreign shipments of larger bulk aggregate shipments show an increase at 306,094 tons for the past week, against 294,344 tons in the preceding week, and 296,433 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

SHIPMENTS continue on a fairly active scale from this district, but the tone of the market shows no improvement as compared with a week ago. In fact, the market is notably weaker, and it is somewhat difficult to say what prices exactly are, owing to the individual position of collieries varying to some extent. Collieries are not quoting quite as low as some of the middlemen who hold coals on contract, and have to find a market abroad for them, which is far from being an easy matter. Unfortunately, the inquiry from the Continent is very slow, except for a few grades, such as coking smalls and highly bituminous qualities. Foreign buyers have for some time held the view that prices would fall, and they do not think that the decline has come to an end, although prices have given way fully 7s. 6d. per ton in the past few weeks. It cannot be said that the market has yet reached bottom, but it would not be surprising if before very long steadier conditions were to become in evidence, for the reason that it is not improbable that shortly the lower prices prevailing will set on foot an additional amount of inquiry. At the moment, the collieries have a fair amount of tonnage in dock and on stem, but their position is not as strong as was the case a week or two ago, and the fact that the loading conditions have eased down is shown by the way collieries in some instances are intimating to their contractors to bring along their tonnage. At the moment there are no outstanding orders pending, with the exception of the Egyptian State Railways' requirements of 160,000 tons for delivery over the second half of the year, and for which tenders had to be in during the early part of this week. The result is awaited with considerable interest, as the prices which have been sent and which may be accepted will form some guide as to other business which may come along for delivery over the latter half of this year.

Rapid Coal Shipment.

So much has been heard in the past concerning the need for speeding up the shipments at South Wales ports and the superiority of other districts in this respect, that it is somewhat refreshing to learn of a notable exception. It is claimed that the introduction of the partial third shift of working is responsible to some extent for the instance of quick loading which last week occurred at the Cardiff docks. The vessel concerned was the French steamer P.L.M. 25. The steamer commenced loading at 11 a.m. on Friday, and by 12.10 noon on Saturday completed loading 8200 tons of cargo and bunkers, and was able to sail later in the day. As a matter of fact, had it not been that No. 6 crane broke down on Saturday morning, causing slower tipping work, where the largest quantity was required, the steamer would have finished loading before noon. Out of the full quantity shipped, no less than 5000 tons of the coals were from the Powell Duffryn collieries, and it is interesting to note that the total quantity of Powell Duffryn coal handled at the Cardiff docks on Friday last week was over 12,000 tons.

Anthracite Combine.

Reference was made in a recent letter to the acquisition of the Cleeves Western Valleys Anthracite Collieries, Limited, and the Gurnos Anthracite Colliery, Limited. It has now been disclosed that the undertaking acquiring these properties is a company formed with the name of the Amalgamated Anthracite Collieries, Limited, and with a nominal capital of 2½ millions sterling. The amount involved in the purchase of the two undertakings mentioned runs to about 1½ million sterling. A public issue is to be made in the latter part of next week, when a portion of the capital, amounting to £1,600,000 in £1 shares, will be offered at the price of 21s. per share. Sir Alfred Mond will be the chairman of the new company, and the directorate will include Mr. Dalziel, of Higginson and Co., the well-known London City bankers; Lord Ashfield; Mr. T. P. Cooke, of Swansea; and Mr. A. J. Harries, the present managing director of Cleeves, Limited.

South Wales Miners' Conference.

During the past week the annual Conference of the South Wales Miners' Federation has been in progress at Cardiff, so that no one will be surprised if some drastic decision is come to on some subject or other. The Conference is generally expected to produce something of special interest. On this occasion it has passed a resolution that three months' notice should be tendered as early as possible to terminate the present agreement. This decision only confirms a previously expressed attitude towards the agreement, but it is not to be supposed that the South Wales body will do anything independently of the Miners' Federation of Great Britain. The Conference also passed a resolution that membership of the Federation should be made a qualification for employment in or about the mines, and that in order to avoid the continual stoppages of collieries owing to non-unionists, the owners should be approached with a view to an agreement being entered into "confining the benefits of the Conciliation Board to persons who are members of the Federation." It was only natural that there should be some reference to the fight which has been going on in the coalfield between the Federation leaders and the Mechanical Workers' Union. Complaints were made at the Conference that members of the Federation were being persecuted and prosecuted for peacefully exerting influence in order to secure an efficiently organised coalfield, and the result was that it was resolved that a special conference should be called to consider the prosecutions of Federation members for carrying out a show of cards and picketing, with a recommendation that the Conference should determine that if these prosecutions are proceeded with, fourteen days' notice should be given throughout the coalfield.

S.W.M.F. Balance Sheet.

The balance sheet of the South Wales Miners' Federation affords interesting reading. The membership for 1922 was 87,080, as against 117,610 for 1921 and 197,668 for 1920. The total income last year was £70,555, compared with £282,235 for 1921. The total value of funds at December 31st last is given at £39,093, which compares with £58,153 for 1921, and £283,584 for 1920. The Federation evidently exercised more than usual economy, inasmuch as its total expenditure last year was £43,992, as against £301,295 in 1921 and £427,614 in 1920.

Current Business.

The current demand on the steam coal market is very quiet, and the attitude of most foreign buyers is that of holding off until they consider that prices have fallen to the utmost extent. Values have certainly given way since I wrote a week ago, and although some of the collieries are quoting 34s. to 35s. for best Admiralty large, it is very much to be doubted whether they are getting any business at these figures, inasmuch as middlemen are prepared to sell at prices at least 1s. 6d. to 2s. per ton less. Best small coals are in the neighbourhood of 27s. 6d., but smithy smalls are quoted at as much as 32s. 6d., owing to the fact that the demand for them is so active and the quantity available is so limited. In the anthracite section the tone is firmer, especially for sized qualities. Collieries are fully sold for the next two or three weeks, and in some instances for an even longer period. Best anthracite nuts are quoted up to 65s. per ton, and cobbles are on the same mark. Peas are practically unobtainable, and beans are firm at 45s. to 47s. 6d. Rubbly culm and duff coals are also scarce and recent prices are well maintained.

EXPERIMENTS have been carried out at the Münchentuchsee (Berne) station in the reception of American radio messages. The success attained was such that it was decided to open a regular public service on June 1st.

OLD MACHINE TOOLS IN INDIA.

We learn from a correspondent that some of the earliest machine tools made in India have recently come to light. One is a lathe made at the Gun and Shell Factory, Cossipore, in 1847, by Colonel A. Broome, Bengal Artillery, the then superintendent of the factory. This lathe was described as screw cutting, 12in. centre, bed 11ft. long. The headstock was fitted with a four-step cone pulley and was double geared. The lead screw, ¼in. pitch, was situated inside the double bed, with lock-nut to take up end play, and was driven by the ordinary change wheels on an adjustable quadrant. This screw was the only means of imparting mechanical feed to the saddle. The saddle was of good proportions, with extension for avoiding side play. The tool rest was in two parts, the lower sliding in a T slot on the saddle, the upper revolvable through a large arc and fitted with fine screw adjustment. During the Great War the headstock, tailstock and upper part of the tool rest were taken to improvise special purpose machinery, and the lathe bed was put on the scrap heap, where it was recently found.

Another lathe of the same date by the same maker is still in use for rough work at the Metal and Steel Factory, Ishapore. Two other lathes, smaller, made in the Gun and Shell Factory, Cossipore, in 1860, were used throughout the Great War and sold by auction in 1922. They fetched Rs. 175 and Rs. 90 respectively. Two special purpose machines made at the Gun and Shell Factory in 1876 at a cost of Rs. 800 each have recently been condemned, as the last shells for which they could be used have now been declared "Obsolete for future manufacture." They were specially adapted for turning and screwing the mouths and sockets of shells to suit the old general service gauge for fuses. They were of the lathe type with no tailstocks, fitted with a capstan rest carrying four tools. The tools could only cut screws of fourteen threads to the inch. These machine tools were used during the Great War in making some of the very old pattern ammunition required for special purposes.

CONTRACTS.

MELDRUMS Limited, of Timperley, have during the past twelve weeks received orders for forced draught furnaces for a brewery, gasworks, public baths, laundries, tar distilleries, timber works, a pottery, a dockyard, a steam tug, a pumping station, a colliery, an india-rubber factory, &c.; for destructors for a large estate, a boot factory, H.M. Office of Works, a big railway group, a motor firm, &c.; for gas scrubbers for benzol and ammonia recovery; for a complete shale oil by-product recovery plant; for a complete condensing plant for gases; and for dryers and furnaces for road metal.

SIR W. H. BAILEY AND CO., Limited, of Albion Works, Salford, Manchester, inform us that amongst the orders they have recently received are the following:—Sill recorders for recording the flow of sewage, sluice valves, penstocks and sediment separators, for the Salford Corporation sewage scheme; two "Davidson" direct-acting deep-well pumps for the Tang, Terry Railway; train recorders for the Crown Agents for the Colonies; turnstiles and entrance gates for the South Shore baths, Blackpool; turnstiles for the Manchester City football ground; wet vacuum pump for Southend waterworks; and G.M. valves, expansion joints, steam traps and cocks for Portsmouth Dockyard.

CATALOGUES.

THE UNDERFEED STOKER COMPANY, Limited, Coventry House, South-place, London, E.C. 2.—Illustrated pamphlet describing the "Lopulco" system of pulverised fuel plant for the Société Anonyme Union d'Electricité, Paris.

WILLIAM BEARDMORE AND CO., Limited, Glasgow.—A well illustrated artistic catalogue of the firm's steel products, describing the Parkhead and Mossend Steel Works and various applications of Beardmore steel for shipbuilding, marine engineering, railway, and industrial purposes.

MATHER AND PLATT, Limited, Manchester.—Sectional catalogues of alternating-current and direct-current generators for coupling to steam turbines through gearing. The alternating-current generators are of the rotating field type with stationary armatures, and are made with either one or two bearings. Illustrations of both types of machine up to 1500 kilowatts capacity are given.

THE NEW BART ON POWER STATION.—With reference to the description of the New Barton Power Station, which was published in our issue of June 15th, and in which it was stated that, with the exception of three "Weir" boiler feed pumps, the whole of the pumping plant has been supplied by Mather and Platt, Limited, we are asked by W. H. Allen, Sons and Co., Limited, of Bedford, to say that the condensate extraction and feed delivery pumps for that station were made by them, and that they have received a repeat order for an extension of the same plant.

WHY RESEARCH IS NECESSARY.—Possibly no industry, says the *British Cast Iron Research Association*, requires assistance such as can only be given by research more than the ironfounding industry. In the cast iron field, metallography has not made as much impress as it has in the steel industry. A few metallurgists have developed the microscopic study of malleable iron until the annealing operation is becoming better understood, but little of practical value for the grey iron foundryman has been obtained through microscopic investigation. From time to time articles on the microstructure of grey iron have been published, particularly by Professor Bauer. These articles have given an idea of what might be done from the further investigation of this product under the microscope. The condition of carbon also offers an important field for investigation. In steel, the state in which the carbon exists effects a marked influence, and has been studied under the microscope. Microscopic investigation of carbon in grey iron has been confined largely to examining the shape and size of the graphite particles, but little has been indicated regarding the effects producing the different states of the graphite which was not already known. It would appear that research must go deeper and study the graphite formation at higher magnifications. Already investigations by the Association have shown the complexity of the graphite grain of which graphite is only a part. Possibly when the nature of the graphite particle is understood, a method of controlling it to give higher physical properties to the grey iron may be evolved. Once these problems are solved the results will be turned over for practical application; the beneficial results arising from work of this character can only be measured as the various problems awaiting solution are tackled by the Association.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. Coast—	
Native	—
Foreign (a.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) **Scotland—**		
Hematite	5 17 6	—
No. 1 Foundry	5 15 0	—
No. 3 Foundry	5 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 15 0	5 15 0
No. 1	5 15 6	5 15 6
Cleveland—		
No. 1	6 7 6	6 7 6
Silicious Iron	6 7 6	6 7 6
No. 3 G.M.B.	5 16 0	5 16 0
No. 4 Foundry	5 12 6	5 12 6
No. 4 Forge	5 10 0	5 10 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge *	—	—
,, ,, Foundry	5 7 6 to 5 10 0	
(3) Northampton—		
Foundry No. 3	5 2 6	—
,, Forge	4 12 6 to 4 15 0	—
(3) Derbyshire—		
No. 3 Foundry	5 2 6	
Forge	4 17 6	—
(3) Lincolnshire—		
Basic	6 0 0 to 6 10 0	
Foundry	5 10 0	—
Forge	5 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 10 0†	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
Yorks.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 5 0	—
Gas Tube Strip	12 15 0 to 13 0 0	

STEEL.

	(6) Home £ s. d	(7) Export. £ s. d.
(5) **Scotland—**		
Boiler Plates	13 0 0	—
Ship Plates ¼in. and up	10 5 0	-
Sections	10 0 0	—
Steel Sheets ⅛in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 0 0	—
Joists	10 0 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 15 0	—
Soft Billets	10 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0†	—
Light ,,	12 0 0†	—
Billets	11 0 0†	—
Manchester—		
Bars (Round)	11 10 0 to 11 15 0	
,, (others)	10 5 0 to 10 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 5 0 to 10 10 0	
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 15 0	—
Intermediate Basic	10 10 0	—
Soft Basic	8 15 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0	—
Midlands—		
Small Rolled Bars	10 15 0 to 11 0 0	
Billets and Sheet-bars	8 10 0 to 8 15 0	
Gas Tube Strip	11 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 2 6 to 19 5 0	
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 15 0 to 11 0 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½ to 23/3
Block Tin (cash)	187 15 0
,, (three months)	188 12 6
Copper (cash)	66 12 6
,, (three months)	67 0 0
Spanish Lead (cash)	25 2 6
,, (three months)	24 12 6
Spelter (cash)	29 5 0
,, (three months)	29 10 0
Manchester—	
Copper, Best Selected Ingots	71 0 0
,, Electrolytic	74 0 0
,, Strong Sheets	100 0 0
,, Loco Tubes	0 1 2
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 2½
Lead, English	26 10 0
,, Foreign	25 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£50 0 0	18/-
,, ,, 1 p.c. ,,	£60 0 0	21/-
,, ,, 0·75 p.c. carbon	£70 0 0	22/6
,, carbon free	1/6 per b.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 0 0 scale 6/- per unit	
,, Vanadium	16/9 per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	21/-
,, ,, Ell	22/3
,, ,, Splint	23/3 to 24/6
,, ,, Trebles	23/-
,, ,, Doubles	22/-
,, ,, Singles	20/6
Ayrshire—	
(f.o.b. Ports)—Steam	21/-
,, ,, Splint	23/3
,, ,, Trebles	23/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	21/- to 25/-
Screened Navigation	30/-
Trebles	24/-
Doubles	22/-
Singles	21/-
Lothians—	
(f.o.b. Leith)—Best Steam	24/-
Secondary Steam	21/6
Trebles	24/6
Doubles	22/6
Singles	21/-

ENGLAND.

(8) **N.W. Coast—**	
Steams	31/6
Household	46/6 to 57/6
Coke	48/-
Northumberland—	
Best Steams	27/- to 28/-
Second Steams	25/- to 26/-
Steam Smalls	15/6 to 17/-
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	31/- to 32/6
Second	30/- to 31/-
Household	25/- to 28/-
Foundry Coke	60/- to 65/-

Sheffield—	Inland.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	25/6 to 27/6 —
,, ,, House	23/- to 24/6 —
,, ,, Large Nuts	20/6 to 22/6 —
,, ,, Small ,,	18/- to 21/- —
Yorkshire Hards	22/- to 24/- —
Derbyshire ,,	21/- to 24/- —
Rough Slacks	12/- to 14/- —
Nutty ,,	11/- to 13/- —
Smalls	7/- to 9/- —
Blast Furnace Coke (Inland)	31/- to 32/-
,, ,, ,, (Export) f.o.b.	40/- to 42/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	33/- to 35/-
Second ,, ,,	31/6 to 32/6
Best Dry Large	33/- to 34/-
Ordinary Dry Large	32/6 to 33/-
Best Black Vein Large	30/- to 32/6
Western Valley ,,	30/- to 32/-
Best Eastern Valley Large	30/- to 32/-
Ordinary ,, ,,	28/- to 30/-
Best Steam Smalls	25/- to 27/6
Ordinary ,,	23/- to 25/-
Washed Nuts	32/6 to 35/-
No. 3 Rhondda Large	37/- to 38/-
,, ,, Smalls	29/- to 31/-
No. 2 ,, Large	29/- to 30/-
,, ,, Through	25/- to 28/6
,, ,, Smalls	24/- to 25/-
Coke (export)	60/- to 65/-
Patent Fuel	38/- to 40/-
Pitwood (ex ship)	30/- to 30/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	50/- to 55/-
Seconds	45/- to 47/6
Red Vein	34/- to 35/-
Machine-made Cobbles	62/6 to 65/-
Nuts	57/6 to 62/6
Beans	45/- to 47/6
Peas	25/- to 26/-
Breaker Duff	12/6 to 13/-
Rubbly Culm	18/- to 19/-
Steam Coals:	
Large	26/- to 27/6
Seconds	23/6 to 26/-
Smalls	18/- to 22/-
Cargo Through	22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest Quotations available.

French Engineering Notes.

(From our Correspondent in Paris.)

Coke Production.

THE situation of blast-furnace proprietors has not been improved by the growing feeling of uncertainty that prevails with regard to the future supplies of coke from the Ruhr. With the consignments coming from that district they have been able to increase the production of pig iron, and to lay up stocks of coke in case of emergency, although the stocks would not keep them going more than two or three weeks, and as the Ruhr ovens are producing very little, the future is anything but reassuring unless the troubles incidental to the occupation are settled in a short time. Accordingly, blast-furnace proprietors are investigating every means of relieving themselves from a dependence upon foreign coke. This is a problem urgently requiring a solution, for until sufficient supplies are procurable at home there can be no hope of the metallurgical industries developing normally. It is quite possible that a final solution will be found in an interchange of Westphalian coke and Lorraine iron ore, but as the coke is due to France under the Treaty, the Government has so far refused to entertain any bargain of this kind. Nevertheless, it is argued that France can very well produce all the coke she needs with the aid of coal from the Ruhr, which would be obtainable much more easily than the coke. If more ovens have not been constructed in this country, it is due to the low price at which Westphalian coke is supplied under the Treaty, but as the metallurgical industry cannot be dependent upon what is coming from hostile sources, it is hoped that something will be done to encourage the construction of ovens in France, where coke of sufficient density could be produced from coal imported largely from the Ruhr basin. The troubles incidental to the separation of the Lorraine iron ore district from the Westphalian coalfield are so serious that the outcome of the present difficulties will certainly be a considerable development of the home coke-producing industry, while it appears that something may be done eventually with the distillation of inferior coal in two or three stages, so as to produce coke of sufficient hardness for blast-furnace purposes.

Trade Activity.

The fact that a large volume of business is being done at a time when production costs are increasing with the high cost of raw material and high wages, is curiously significant of the soundness of the industrial situation as a whole. If an account were taken of all the important public and private works which it is proposed to put in hand in France and in the Colonies, it would be found that the engineering trades would experience some difficulty in executing the contracts, but as the majority of them are being held up until the financial situation improves, the work distributed is usually sufficient to provide fair activity for engineering shops. The belief that there will be a big recovery in the future is shown by the amount of money being spent upon works extensions. To take only one instance, the construction of weaving looms is making great headway, and large orders are obtainable by firms which are prepared to manufacture them. Until the last few years practically the whole of the looms were of British manufacture, and despite the exchange rates the prices of British looms ought to be favourable to their importation. Nevertheless, there is a desire to give preference to French makers wherever possible. In the same way there has been a considerable development in the manufacture of woodworking machinery. For the time being the market seems to be saturated with these machines, and that branch of industry at least is passing through a very quiet period. The facility with which orders are obtainable is all the more remarkable because prices are necessarily high, although profits have often to be cut very fine to prevent the prices from becoming prohibitive. Much of the work, moreover, is being done on account of reconstructed factories for which it is an accepted policy to give preference as far as possible to French firms.

The Tariff Problem.

The development of the machinery and other trades has created a factor in the fiscal problem that would appear to encourage further protection if it were not for the experience of trade generally that high tariffs protect a class at the expense of the community. This fact has been brought home to the country by a statement last week by the Minister of Agriculture that the Government had sanctioned higher import duties on wines with a view of protecting the viticultural industry. As the duties are aimed principally at Portugal, Spain and Greece, with which countries commercial treaties are either in force or in negotiation, the new policy practically means a suppression of the short-term commercial arrangements which have been the keystone of the French commercial policy since the Armistice. It was only after very laborious negotiations that a commercial treaty was concluded with Spain, with results that are admitted by the French to have been highly satisfactory, but, in view of the statement by the Minister of Agriculture, it is reported that reprisals are contemplated, beginning with the refusal of Spain to renew the treaty at the end of the first year's operation. This announcement of high duties on wines, implying, as it does, that other foreign products and goods may eventually share the same fate, has aroused strong protest from the Chambers of Commerce and industrial associations, which regard this new move as influenced by political considerations. All these commercial and industrial bodies know very well that foreign trade can only be developed on a fair basis of reciprocity, without reprisals, and they are all urging upon the Government to continue negotiations for short-term treaties until such time as the Government can settle upon a well-defined commercial policy. It is announced, indeed, that in view of the Minister of Agriculture's statement an attempt will be made to force the Government to declare the policy it intends to adopt in the future. Evidently the situation is far from being clear, for even the new Tariff Bill is being held up on account of the objections of manufacturers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

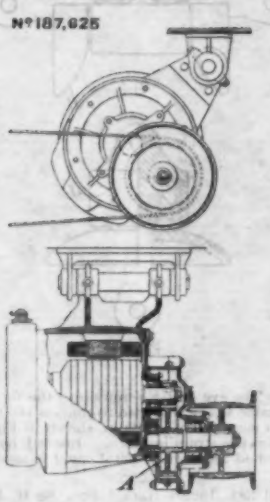
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

187,625. October 21st, 1922.—IMPROVEMENTS IN AND RELATING TO DYNAMOS FOR THE LIGHTING OF VEHICLES, Emile Dick, of 3, Chemin de l'Escalade, Geneva, Switzerland.

This invention relates to a dynamo for the lighting of vehicles which is actuated by means of a transmission arrangement from

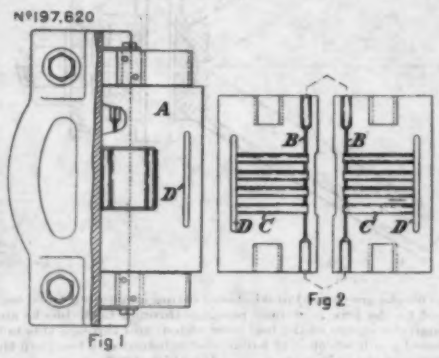


one of the axles of the vehicle. The transmission gear A is arranged in the cover at the driving side of the dynamo frame, the latter being suspended in a pendulous manner.—*May 24th*, 1923.

SWITCHGEAR.

197,620. November 10th, 1922.—FUSES, Switchgear and Cowans, Limited, and E. D. Rodway, Elsinore-road, Old Trafford, Manchester.

In this fuse holder the flash which occurs when the fuse blows is smothered by being forced to find egress through narrow passages. These passages are composed of grooves formed in the faces of two blocks of heat-resisting insulating material that are

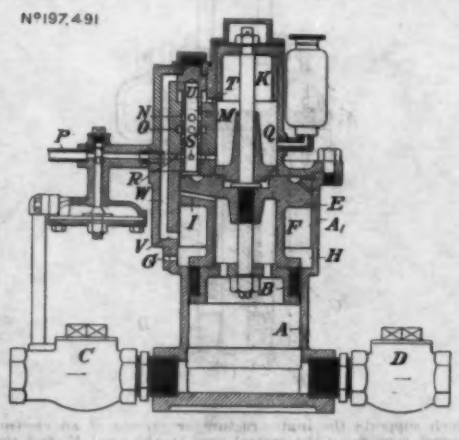


clamped on opposite sides of the fuse. These blocks are shown at A in Fig. 1. In Fig. 2 they are shown separated. B is the groove for the fuse wire, while C C are the grooves to form the passages referred to. These passages open into the lateral slots D D which, in turn, are open to the atmosphere.—*May 17th*, 1923.

PUMPING AND BLOWING MACHINERY.

197,491. March 31st, 1922.—DIRECT-ACTING PUMPS, J. E. L. Ogden, Penshurst, Lincoln Drive, Liscard, Cheshire.

In this pump a piston K acts to raise the piston B for the

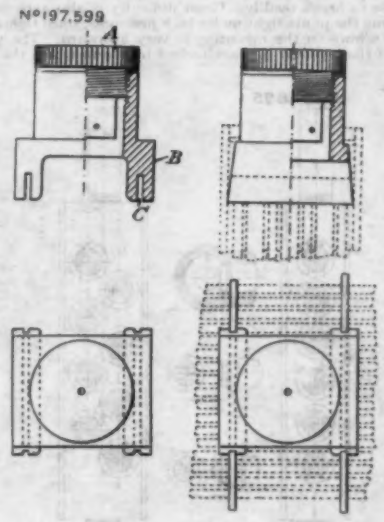


suction stroke. The passage of compressed air to the upper side of the piston head E to effect the pump delivery stroke is controlled by the piston type valve M. The operation of the latter valve is as follows:—When the piston B is in its lowest position—that is, at the end of a delivery stroke—the lower end of the valve M projects into the cylinder A_1. The upper side of the piston E is in communication with the atmosphere by way of the hollow interior of the valve M, the ports N in the latter and the annular passage O. The position of the ports N is then as shown by the dotted circle. Compressed air from the pipe P flows into the cylinder Q containing the piston K by way of the annular passage R in the casing surrounding the valve M. The pressure of such air raises the piston K until the piston E strikes the valve M and lifts it so as to put the ports N out of communication with the passage O and the ports S into communication with the passage R. Compressed air now passes into the valve M and the cylinder A_1. The pressure of such air completes the lifting movement of the valve M. The piston E now descends and the air from the cylinder Q passes into the cylinder A_1 along with air from the supply pipe P. The delivery stroke of the pump now takes place. At the end of such stroke the port T in the cylinder Q becomes uncovered by the piston K and exhausts the contents of the chamber U to atmosphere. At the same time the port V in the cylinder A_1 is uncovered by the piston E and the compressed air above the latter passes by way of the passage W to the upper end of the piston valve. These two operations result in the latter being forced downwards to its lowest position with the ports N in communication with the exhaust passage O and the ports S cut off from the passage R. The cycle of operations is then repeated.—*May 17th*, 1923.

BATTERIES AND ACCUMULATORS.

197,599. August 31st, 1922.—BATTERY VENTS, H. M. Genese, G. R. N. Minchin, and Pritchett and Gold and E.P.S. Company, Limited, 50, Grosvenor-gardens, Victoria Gardens, London, S.W. 1.

According to this invention a vent for storage batteries is combined with a bridge piece so arranged as to press down upon and thus hold the battery plates and separators in position, the whole forming a simple, cheap and efficient contrivance for the purpose. Means are preferably provided for extending the

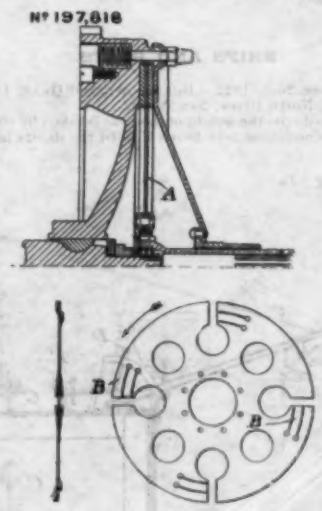


bridge pieces when required. The vent portion A is of the usual form and is made of porcelain. The body part is extended downward, as shown at B, to press on the top of the battery plates, while grooves C are provided to accommodate ebonite strips, so that the device may be applicable to wide batteries.—*May 17th*, 1923.

TRANSMISSION OF POWER.

197,816. April 10th, 1922.—CLUTCHES, S. Smith, 7, Oxford-road, Gunnersbury, London, W. 4; and Auto-Carriers, Limited, Thames Ditton.

In this clutch the driven plate A is provided with a number of



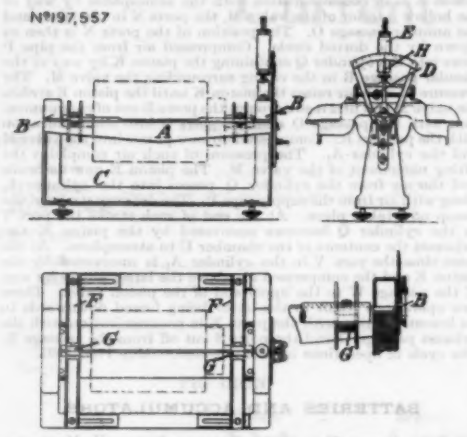
tongues B which are bent out of the plane, towards the driving member, so that they have a trailing action as the clutch takes up the drive.—*May 24th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

197,557. June 2nd, 1922.—BALANCING MACHINES, W. and T. Avery, Limited, and H. N. Cox, Soho Foundry, Birmingham.

In this balancing machine a swinging frame A is mounted on knife edges B B in a level frame C. The swinging frame is balanced by means of the adjustable weights D and E. It is

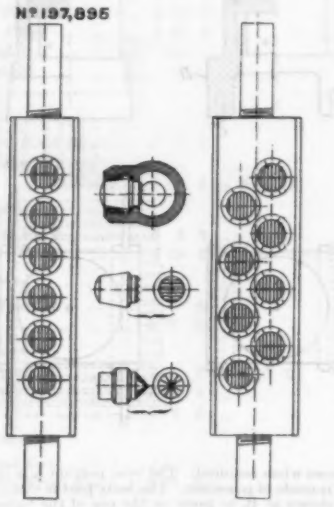
provided with bearers F for carrying the object to be balanced, which is supported in V blocks G G. The centre line of these V blocks is in line with the knife edges. If an unbalanced object



is placed in the frame the frame will rock and the extent of the movement will be shown by the pointer H.—*May 17th*, 1923.

197,895. January 5th, 1923.—WATER LEVEL GAUGES, R. Boizard, 11, Boulevard St. Germain, Paris.

According to this specification, with single reflecting water gauge glasses faceted or fluted on the inner surface, as hitherto known and used for high-pressure boilers and other apparatus, the upkeep is very costly, because successive expansions cause the glass to break readily. Great difficulty is also experienced in keeping the joints tight under high pressures, since tightening the set screws on the mounting is very awkward. The water gauge of the inventor is characterised by the fact that the very

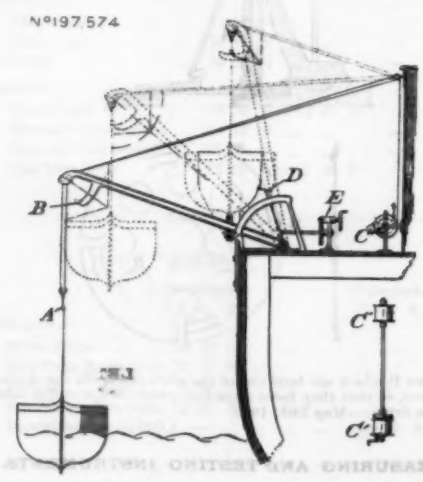


fragile single-faceted glass of existing types is replaced by a plurality of juxtaposed small-faceted or fluted glasses. Owing to each of the reflecting glasses, preferably circular, having its independent tightening and leakage preventing means, the union can be easily effected and leakage prevented. Should some of the glasses of the gauge become broken or spoilt, they will be much cheaper to replace than a single piece reflecting glass and the general upkeep of the gauge will prove far less expensive. As to the level reading, it will be facilitated, since it is necessary only to distinguish black spots from brilliant spots, each small glass acting according as it is immersed or not on one side.—*May 24th*, 1923.

SHIPS AND BOATS.

197,574. June 26th, 1922.—BOAT LOWERING GEAR, D. Maggi, Pier 25, North River, New York.

With these davits the weight of the boat is taken by stoppers A on the slings engaging with horns B until the davits have been



swung clear of the ship's side. It is thus impossible to lower the boat in a dangerous position. The falls of the two davits at the bow and stern of the boat are taken to drums C C fixed on one shaft. When stowed the boat is held against chocks D by a clamp that grips the keel and is operated by the gear E.—*May 17th*, 1923.

MISCELLANEOUS.

197,490. March 31st, 1922.—ELECTRIC INSULATORS, A. E. Wilson, Conholt, Beaconsfield-road, Blackheath, Kent; and Callender's Cable and Construction Company, Limited, Hamilton House, Victoria Embankment, London, E.C. 4.

The insulator A is made of moulded material, two of these insulators being required for the strain insulator shown in Fig. 1. Each insulator is formed at one end with a shed or petticoat B and terminates at the other end in a boss C into which is moulded a metallic cone D. The screwed outer metal ring E is moulded

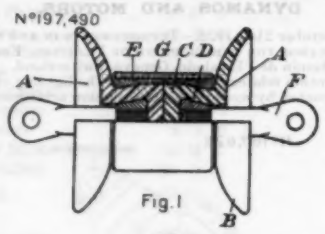


Fig. 1.

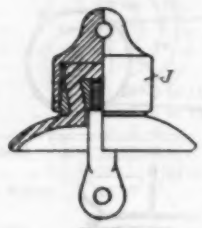
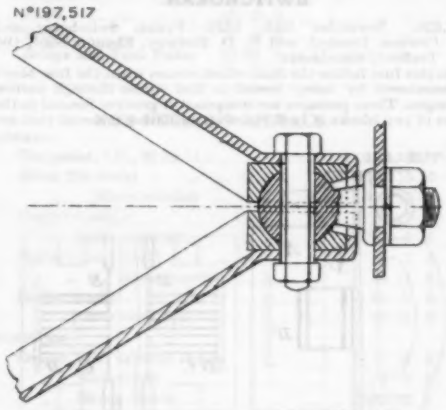


Fig. 2.

into position. The eye bolt F screws into the metallic cone D. A screwed metallic sleeve G is used to connect the two insulators together. The suspension insulator shown in Fig. 2 is practically the same as the strain insulator. Instead, however, of two insulators fastened together, a metal cap J is used.—*May 17th*, 1923.

197,517. April 25th, 1922.—BALL JOINTS, Sir H. Austin, Lickey Grange, Broomsgrove, Worcestershire.

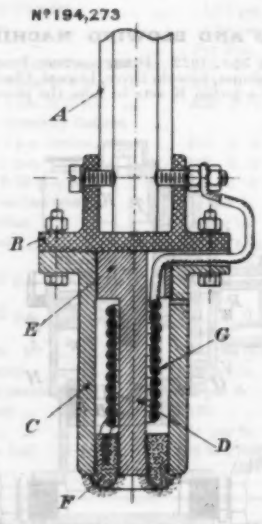
A ball joint constructed according to this invention comprises a ball rigidly connected to or formed in one piece with a neck which, in the case of front axle torque rods, is bolted or otherwise secured in relation to the chassis frame. Two blocks are provided, each having a spherical cavity to fit over the ball, and



these blocks are carried in whatever fitting is required to be connected to the joint. A hole passing through both blocks and through the centre of the ball is provided, and through this hole is passed a bolt which is of a diameter substantially less than the diameter of the hole in the ball.—*May 17th*, 1923.

194,273. February 6th, 1922.—DEVICE FOR RUPTURING ELECTRIC ARCS, *Forges and Ateliers de Constructions Electriques de Jeumont, of 75, Boulevard Haussmann, Paris.*

Upon the centre fixed conductor A is secured an insulator B



which supports the iron structure or carcase of an electro-magnet comprising the central core D, the head E, and the cylindrical sheath C. The rupturing contact F takes the form of a ring and is fixed concentrically between the ends of the core D and sheath C, in such a way that its lower surface is situated in a radial magnetic field which is produced at the interpole gap of the electro-magnet when current passes through a winding G enclosed between the core D and sheath C, the ends of this winding being connected to the rupturing contact F and the fixed conductor A respectively. The same arrangement can evidently be reproduced at the lower contact upon the movable conductor of the switch. When an arc is produced at the separation of the contacts the radial magnetic field acts upon the portion of the arc and current between the magnet poles, so as to cause this portion to move in a circular path over the rupturing contact, and at the same time to impede the movement of the ions projected from the arc craters, the former action being due to the counter-electromotive force generated by the circular motion of the current elements of the arc in the radial magnetic field of the magnet, and the second action due to the deviation and the curvature of the path of the ions in the interior of the arc. The presence of the electro-magnet upon one of the rupturing contacts of the switch allows it to be utilised as a magnetic retaining device if one or other of the contacts is provided with a quick-break movement. In this case the two switch contacts may be fitted with the device as shown, with opposite magnetic poles for the corresponding parts of the two magnets, or again, one of the rupturing contacts may be fitted in a plain armature or keeper made of iron, through which the lines of force of the electro-magnet of the other contact member will be closed when the two members are in contact.—*May 24th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

PHYSICAL SOCIETY OF LONDON.—Imperial College of Science, South Kensington, S.W. 7. Lecture, "The Excitation and Ionisation Potentials of Gases and Vapours," by Professor F. Horton. 5 p.m.

NEWCOMEN SOCIETY.—Summer meeting at Rochester.

MONDAY TO FRIDAY, JUNE 25TH TO 29TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting at Glasgow. For programme see page 615.

MONDAY TO SATURDAY, JUNE 25TH TO 30TH.

INTERNATIONAL AIR CONFERENCE.—At the Institution of Civil Engineers, Great George-street, S.W. 1. For programme see page 587.

WEDNESDAY TO SATURDAY, JUNE 27TH TO 30TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Summer meeting at Leeds. For programme see page 534.

FRIDAY, JUNE 29TH.

SOCIETE DES INGENIEURS CIVILS DE FRANCE.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "The Port of Rouen and the Lower Seine," by Monsieur M. Barillon. 8.30 p.m.

MONDAY TO WEDNESDAY, JULY 2ND TO 11TH.

INTERNATIONAL NAVIGATION CONGRESS.—At the Institution of Civil Engineers, Great George-street, S.W. 1. For programme see page 588.

TUESDAY TO SATURDAY, JULY 3RD TO 7TH.

ROYAL AGRICULTURAL SOCIETY'S SHOW at Newcastle-on-Tyne.

WEDNESDAY AND THURSDAY, JULY 4TH AND 5TH.

BRITISH WATERWORKS ASSOCIATION.—Summer meeting at Cardiff. For programme see page 565.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

LIEUT.-COLONEL P. WALTER D'ALTON, M. Inst. C.E., M.I. Mech. E., M.I.E.E., has now opened offices at 199, Piccadilly. Telephone, Regent 5138.

MR. E. W. PETTER, chairman of Petters, Limited, of Yeovil, and managing director of Vickers-Petters, Limited, of Ipswich, has been elected president of the British Engineers' Association

WE are informed that Mr. E. Garcke has, owing to pressure of work, resigned the chairmanship of the North Metropolitan Electric Power Supply Company, a position which he had held since its incorporation, but that he will remain a director, and that Sir James Devonshire, K.B.E., the managing director, has been appointed chairman and managing director. Mr. W. L. Madgen has resigned his position as director of the company, owing to ill-health, and Mr. E. R. Sonmes has been appointed to fill the vacancy.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The summer meeting of the Institution of Heating and Ventilating Engineers was held at Folkestone, under the presidency of Mr. John Watson. At the business meeting, Mr. J. Roger Preston, in an interesting paper, remarked that the cooling of air had been mostly carried out as a necessity in specialised industrial processes, either for the purpose of reducing the humidity by condensing part of the aqueous vapour or for the production of low temperatures. The use of same in this country for the purpose of obtaining comfortable and healthy conditions in our buildings had been very limited, except to the extent of cooling the air within a few degrees of the initial wet bulb temperature, with the usual air washer re-circulating the spray water. Modern physiological research tended to prove the necessity of keeping the wet bulb temperature within narrow limits, say, from 54 deg. to 58 deg., if it was desired to ensure comfortable and healthy conditions. The paper dealt with the means of obtaining conditions approaching this ideal in a building, when hot and humid outside. It was in the memory of many, said Mr. Preston, that an ordinary air washer, for the purpose of cleansing the air, was considered to be a luxury and an expensive one. This, however, was now quite common, and they might see the day when an up-to-date heating and ventilating plant would not be considered in any way complete without a properly designed equipment for cooling and dehumidifying.